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Electrical World

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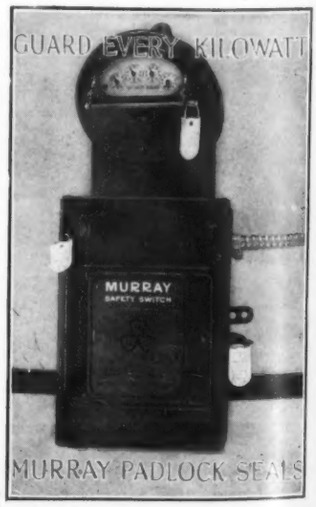

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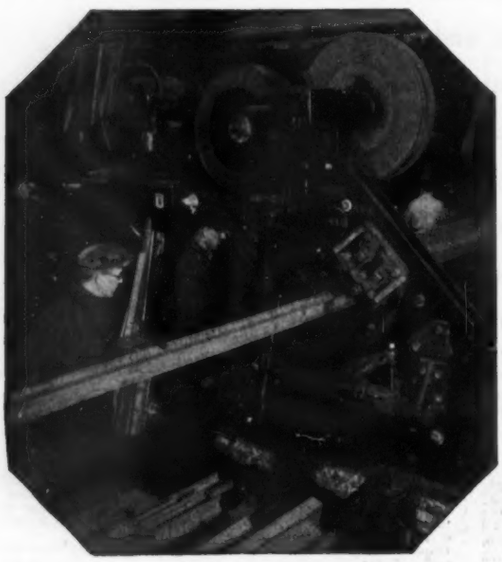
Inspectors Assembling a Substation Tower to Check Accuracy of Fabrication

"One Seeing Is Worth a Hundred Tellings,"

Says a Chinese Proverb

—and a visit to our factory will convince you that we are equipped for and are building the kind of outdoor substations you want. All steel members are accurately cut by the machines pictured below and the absence of burrs or rough edges insures better galvanizing with longer life to the substation structures.

—and after galvanizing the steel members are machine straightened. Are you getting substations with members straightened before shipment—or are your men straightening them at your own expense? It makes a big difference in your final costs. In some cases Unit Type has shown a 20% saving in labor.



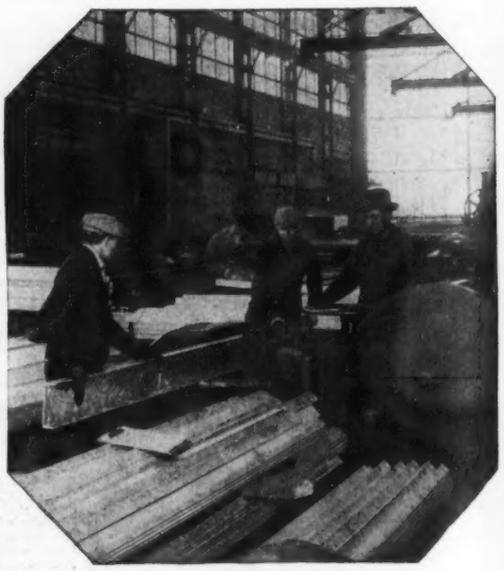
Cutting

ABOVE is an example of double checking. After fabricating the steel was checked against the drawings in the regular way.

But this was a new design of medium capacity station, so we go one step further and assemble a unit.

Furthermore, there were 20 of these stations going out in a sparsely settled territory where factory mistakes would cause the purchaser a lot of trouble and expense.

Just another thing we do to reduce erection costs.



Straightening

Delta INTERCHANGEABLE UNIT TYPE INSULATORS Star

DELTA STAR ELECTRIC COMPANY, 2400 BLOCK, FULTON ST, CHICAGO, ILLINOIS.

Electrical World

Published by McGraw-Hill Publishing Company, Inc.
W. H. ONKEN, JR.
Editor

VOLUME 89 — *New York, Saturday, March 5, 1927* — NUMBER 10

Public Utilities Must View Coal Situation Calmly

INASMUCH as there is a possibility of a strike of union coal miners in some states on April 1, some electric public utility companies may experience inconvenience in obtaining fuel supplies from regular sources. The thing to remember is not to get excited and bid up coal—for the strike will not last long—or to get possessed with the ambition of becoming coal mine owners and operators. Many utilities owning mines have found them to be anything but profitable undertakings, and, besides, coal mining is not as a rule a business for a public utility man.

Statistics indicate that public utilities have on hand the usual month and a half's supply of coal. This is unfortunately the price the utilities must pay for the shortcomings of transportation and mining, but the public does not appreciate just what it means—about four million tons of coal in storage as a safeguard to electric service, involving approximately $15,000,000 in cash drawing no interest; more than that in property on which to store the fuel, with constant disintegration and depreciation in the heat content of the coal, coupled with the ever-present danger of spontaneous combustion. To be charitably inclined toward miners under such circumstances is indeed a great virtue, and those who do not possess it must nevertheless grin and bear it; for these situations will ever confront American industry.

Rate Reductions May Mean Service Handicaps

THE agitation for rate reductions in Massachusetts is typical of the results that may arise from an incorrect knowledge of the utility business. In the minds of many people a false belief exists that the light and power industry is very profitable and that rates are too high. The facts that very few millionaires have been produced in the business and that electric service costs less for the benefits rendered than any other public service are not known. Nor is it understood that the large capital expenditures made each year by the industry are a means to extend and improve service rather than to make money. Credit is not given for the economies introduced into the business whereby rates have been held down and even reduced, nor does the public understand that industry executives have practiced a policy of giving to customers the benefits of all economies beyond a fair rate of return on the money invested and payments to security holders sufficient to establish a credit standing which will permit money to be raised at a low cost.

The two most important economies introduced into the light and power business are this raising of capital at low cost because credit is sound and the decrease of power production costs in steam generating stations by means of improved engineering developments. Other phases of utility operations do not present such a favorable picture because most of the savings realized have been offset by the desire of utility executives to extend service and lower rates. Lines have been extended into lightly loaded areas and to the farms, the capital investment per customer and the energy losses alike increasing; standards of service have been improved, and the capital investment has thereby been increased because of the purchase and use of regulators, protective devices, multiple-circuit feeders and heavier conductors, and dilution has been felt in that extended systems have taken on many small customers, which has resulted in lower service use per customer while the expenses per customer have increased.

Electric service today is cheaper and more widespread than was believed possible a few years ago, and yet the margin of profit per customer is very small. The light and power companies are using their prosperity to extend and to improve their service, and the public benefits. Electric rates are very cheap from the standpoint of value for the money paid. The public as well as the industry would do well to maintain the present reasonably prosperous status, if they expect to extend electric service in this country to new customers and if they expect to improve the service to present customers.

Maine Outlook Improving

PUBLIC interest in the water-power bills before the Maine Legislature literally packed the House of Representatives, its galleries and corridors at protracted hearings last week in Augusta, and the question of permitting power exportation by repeal or modification of the long-established restrictive policy of the state was an all-absorbing topic of discussion wherever men gathered. In legislative circles a genuine desire to achieve something constructive is apparent, and if it were not for the industrious efforts of a few office-hungry politicians to befog the issue, the prospects of making real headway toward shipping surplus power out of the state under commission regulation would be better than at any time in the past decade.

Stripping these political aspects from the situation, such opposition to power exportation as lingers in the popular mind appears due to two fears—first, federal control of Maine's hydro-electric resources and public utilities, and, second, inability of farmers to obtain electric service as a result of energy transmission beyond the state line. Under the terms of the Smith bill, sponsored by the power interests, exportation would be carried on by separately organized transmission-company means only and under the close supervision of the Maine Public Utilities Commission. Generating companies now engaged in power production, transmission and distribution would have no part in the process except to deliver surplus energy to the carrier. The commis-

sion would regulate the delivery of this energy to the state line, and it is believed that in this way Maine would retain control of its water-power resources even should the federal government exercise its constitutional authority over interstate transmission. Intrastate operations would continue as at present, with rates, service and local company financing under the state board's jurisdiction.

As for rural service, which has become popularly identified with the exportation problem through political agitation, it has already been pointed out that revenue derived from the exportation of surplus power would at once increase the resources of the operating companies and thus make more money available for rural-line and other service extensions. A practical proposal to realize this received a storm of applause when President Wyman of the Central Maine Power Company offered an amendment to the Smith bill providing for applying at least one-half the revenue of all companies from surplus power sales outside the state annually for ten years to rural electrical service, with a maximum expenditure per company of $250,000 in one year. In the viewpoint of the general public this cuts to the very heart of the rural problem. Whether the Smith bill, which provides for a referendum next fall, can pass at this session, or whether a measure like Senator Oakes' bill, providing for an investigation of compact possibilities between Maine, New Hampshire and Vermont, with subsequent federal approval, stands a better chance, is uncertain at this writing; but public opinion in the mass is certainly becoming less hostile to surplus power exportation.

Trying Rate Cases on Street Corners

RATE fixing for public utility service is so technical a problem that the so-called man in the street is no more competent to pass upon prices in this field than to substitute for a delayed surgeon in a hospital operating room. It is true that in a democracy public opinion is the court of last resort, but rate cases cannot be properly disposed of by newspaper headlines or by the executive correspondence of public officials with company managers. It is again true that legislatures are the creators of regulative commissions, but upon the latter must fall the delegated and delicate duties of rate, earnings and expense analysis that demand arduous training and broad experience for successful completion.

The pressure of public opinion is heavy upon conscientious public officials, and when such opinion is based on street-corner comments upon weighty affairs, without real understanding of the complex factors involved, it is all the harder for such officials to do their work. Courage to render unpopular decisions is best built upon economic foundations, and attempts to make political capital out of rates or to depress the market value of securities by attacks upon service prices without waiting to go through the normal procedure of regulative inquiry become as dust in the eyes of justice. It would seem as though occasions of this kind offered unusual opportunities for power companies to tell their customers the plain truth about their business, not with the expectation of eliciting sound popular decisions upon the equity of rates, but with the reasonable hope of spreading understanding of company policies and aims and thereby creating an atmosphere more favorable to the just solution by qualified commissioners of the complex problems involved in rate regulation.

The Economies of Diesel Power Production

DEBATES about the merits of the Diesel engine have been current in industry for several years. Many opinions and few facts have been used in the arguments between utility engineers, utility power salesmen, consulting engineers and representatives of Diesel manufacturers. A battle of words has waxed fast and furious in order to gain commercial victories, and selfish interest has too often motivated the forces engaged in the conflict.

That the Diesel engine is a meritorious and successful engineering development and has a place in power production is granted, but its full possibilities have not been investigated and the limits of its economic application have not been defined. Only pro and con arguments, with few data to substantiate partisan opinions, have been available. No organized attempt has been made to determine the economic fields of application of existing engines or to develop still larger engines for use in utility power stations in order to measure accurately the full possibilities of this prime mover.

Manufacturers have been fumbling with their sales and development programs, and the utilities have never investigated carefully the possibilities of this prime mover for generating power on a comparatively large scale. Prejudice and inertia on the part of power engineers, commercial rivalry between engine manufacturers, competition for business between utility power salesmen and Diesel engine salesmen, lack of complete and authoritative data on installations and an absence of any degree of co-operation in a study of the Diesel as a prime mover have introduced handicaps which have prevented much commercial progress.

In this issue H. C. Thuerk presents an article on Diesel power costs. In his capacity as a utility engineer he encountered the Diesel engine as a commercial competitor and was faced with the problem of determining the economics of Diesel power production. He therefore assembled available data on the costs and performances of many Diesel installations and made an analysis which, in his opinion, gave the answer to his commercial problem. Neither his data nor his assumptions will be accepted as conclusive by the industry, and no one can now prove whether he is entirely correct or wholly in error. The article is a worthy contribution because it contains many data and at least gives the basis for an economic analysis of Diesel applications from the standpoint of a utility sales engineer. It also affords positive evidence that the industry has far to go before any general agreement can be had as to the economic place of the Diesel engine in power production.

It is high time that opinions and partisan interests be subordinated to the thought that it is to the interest of the entire industry to find the facts about Diesel applications and to use this prime mover in its economic realm of power production. Facts will show where it should be used in both utility and industrial plants, the latter when isolated-plant service is favored, and the limits should be found and agreed upon by a non-partisan and authoritative committee of the industry.

From an industry-wide standpoint all prime-mover sales and power installations should be made upon the principle of the most economical and satisfactory power supply, whether this involves utility service or turbines, engines, Diesels and other prime movers. Facts as to costs and performances are essential elements in the

making of any decision from the point of view of economics and service.

The Diesel situation calls for a "get-together" meeting of all interested to formulate a program. Co-operative effort has proved to be an effective approach to the solution of other industry problems, and the welfare of the industry should be sufficient incentive to bring about action in this instance. A very definite program can be made through the A.S.M.E., the A.I.E.E. or a non-partisan industry committee. This would include the working out of cost accounting and performance forms, the use of these forms in many Diesel plants, an analysis of the records obtained, and the establishment of principles and facts which would be accepted as accurate and authoritative.

Manufacturers' Load Factor Affects Equipment Prices

AFTER all the concern that load factor has given light and power companies they would not be expected to be oblivious to the effect which production load factor has on equipment manufacturers. It has been called to their attention several times in the last few years by manufacturers with the comment that assistance in improving it will bring returns in the form of reduced equipment costs. For those companies which are not acquainted with the facts, it can be reiterated that demands for turbo-generators, for example, are so spasmodic throughout a single year and from year to year that manufacturers' production facilities stand relatively idle at times and are severely overtaxed at other times. The fixed charges, expense and inefficiency inherent in adjusting production facilities to such wide changes in demands are reflected in the customer's equipment. The extent to which this condition applies in other branches of manufacturing varies and is a subject which manufacturers collectively should specifically present to light and power companies collectively with an estimate of how much the latter could expect to benefit if they assisted in smoothing out the load factor.

Assuming that utilities would be allowed to share in the savings from improved load factor, they have the means in most cases of bringing about the improvement if they act in concert. Even if there were not collective action, it is possible that manufacturers would be willing to give individual companies some incentive to smooth out their respective demand factors. Most electrical utilities know pretty definitely what their generating, transmission, distribution and metering requirements are going to be several years in advance. If they merely told manufacturers these facts, it would assist the latter materially in planning production, even if no agreement were made to purchase in exact accordance with this basis. Furthermore, with such relatively definite demands known in advance, utilities might arrange more extensively than they do at present to have the deliveries spread with a fair degree of uniformity over the year. Some companies which plan ahead are already doing this. Some of the benefits to be expected are discussed on page 531 of this issue in very specific terms based on data furnished by manufacturers. All this suggests a method of reducing equipment costs and consequently fixed charges, with the opportunity of greater returns on the investment. Is it worth while?

Leadership in Refixturing Now Up to the Power Companies

FOR several years there has been much talk about the tremendous market for refixturing the homes of the fifteen and a half million families in America now using electricity for light. It is estimated that in seven and a half million of these homes the lighting equipment is obsolete, and it is believed that if approached in the right way the householders can be sold modern fixtures that will be more decorative and provide better illumination.

The fixture manufacturers and dealers have been talking about doing the job but have got nowhere with it. It seems doubtful that they can be expected to give impulse to such a movement. After several years of planning and predictions there was a combined convention of dealers and manufacturers in Cleveland a few weeks ago. They produced a creditable "fixture market," but there was no evidence either of a united membership interested in an opportunity or of any organized leadership that promises early progress with a refixturing program. And so, since 83 per cent of residence consumption still goes for light, and since virtually all this light flows through fixtures, and since every branch of the electrical industry is vitally concerned with the expansion of this market, it would seem that the time has come when electrical men should look at the situation broadly and decide what is going to be done about it.

One thing is plainly true. Some one other than the fixture industry itself must undertake the job if early and effective action is to be seen. And that some one is obviously the central-station company. For, after all, refixturing entails the pioneering of an idea—the idea of enjoying more beauty and more comfort in the home by substituting more ornamental and effective fixtures in place of the prevalent inferior lighting equipment. It will require the same kind of educational selling that was used to introduce refrigeration, and experience has shown that the burden falls naturally upon the power companies, which can afford to invest money in the building of a popular demand because a profitable load will follow. And in this case the power company has four definite interests involved:

One: *A load-building interest.* Because properly directed, refixturing will increase lamp wattage, but wrongly handled it sometimes reduces consumption.

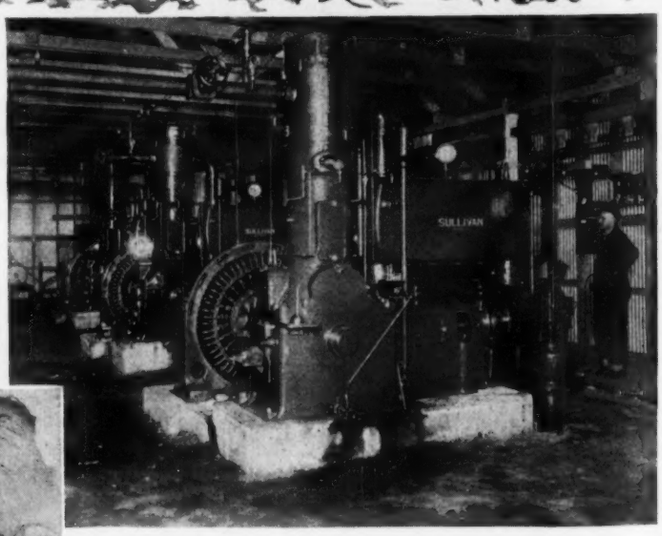
Two: *A public relations interest.* Because once social pride in fixtures is established the appreciation of good fixtures and good light will raise the standard of illumination and build good will.

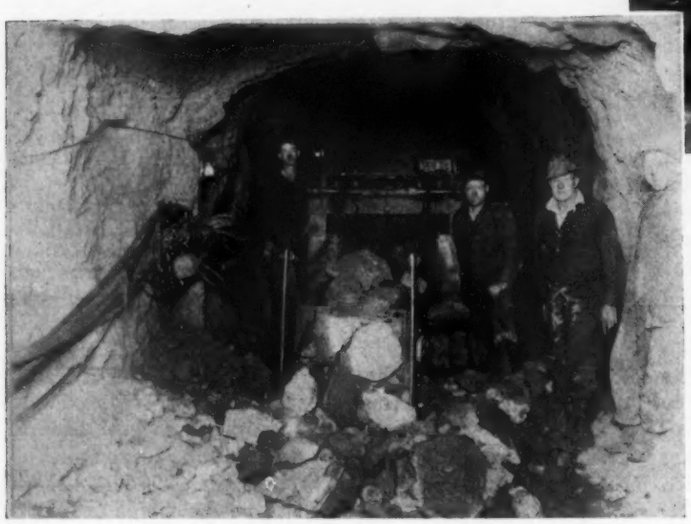
Three: *A trade relations interest.* Because it is just as important that the fixture trade should be healthy as that the appliance trade should prosper, and the power company can benefit the fixture situation much by promoting sales and helping to guide policies.

Four: *A merchandising profit interest.* Because, although the central station never should and never will dominate the retailing of fixtures in the community, many companies will add lighting equipment to the merchandise they sell, and in the matter of margin it will be the most profitable line they carry.

Already the movement is under way. The Ohio Power Company and the Cincinnati, Baltimore, Chicago, Buffalo and Joplin central stations have entered the field with organized selling campaigns. So have others. The kitchen-light campaigns were but a forerunner of this broader activity that is to come. The homes of America must be refixtured. The power companies must take the leadership and start the work now.

Excavation and Tunneling Afford Opportunities for Utilizing Electric Power





ELECTRIC power received from high-tension lines is playing an important function in the construction of the tunnel which the Great Northern Railway is drilling through the Cascade Range. In addition to being used for lighting and heating, electricity is used for such applications as hauling, mucking and driving compressors, furnishing air for drilling and similar operations. Thirty-four electric locomotives, consisting of 6, 10 and 20-ton combination trolley and cable-reel and 6-ton combination trolley-battery types, are used. Eleven motor-driven compressors totaling 2,200 hp. are divided between three compressor houses. All mucking is done by power shovels, two dipper types and two conveyor types being used for drift mucking.

What Are Diesel Engine Power Costs?

Operating Data from 58 Diesel Engine Power Plants Taken as Basis for Computing Fixed Charges, Operating and Maintenance Costs

By H. C. THUERK
Erie Lighting Company, Erie, Pa.

EXAMINATION of the operating cost records of a large number of Diesel oil-engine plants reveals very considerable differences in the reported cost of energy generated. Wide variations occur in fuel oil and lubricating oil consumptions and in maintenance costs. There is also a lack of uniformity in methods of keeping cost records and in arriving at the total cost of power per kilowatt-hour. Good engineering judgment requires that the operating costs of several plants under varying but practical conditions of load, location and attendance be studied and analyzed before drawing definite conclusions.

The method outlined here of determining the cost of generating electric power with Diesel oil engines is based on the average performance of a large number of plants in operation for several years. In Tables I and II are given the operating results of 58 oil-engine plants, having a total installed capacity of approximately 61,000 kw. and having a total annual output of 140,200,000 kw.-hr. An inspection of the results given in these tables shows a wide variation in the efficiencies and therefore in the operating costs of these plants.

FACTORS THAT MUST BE INCLUDED

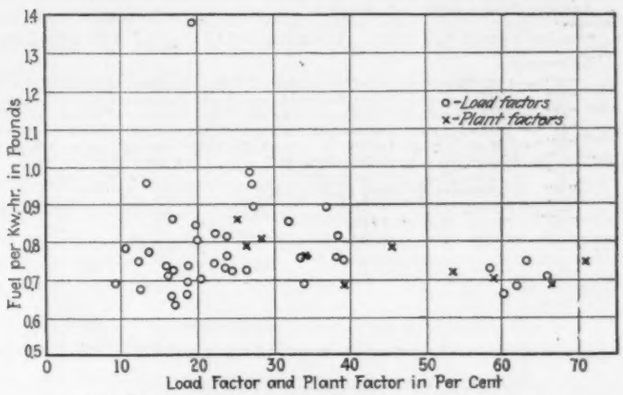
In determining the cost of generating electric power with Diesel oil engines it is necessary to take into consideration all of the items that enter into the total cost. These items include:

1. Fixed charges on the investment, including interest, depreciation, taxes and insurance.
2. Attendance labor.
3. Fuel oil.
4. Lubricating oil.
5. Water for cooling.
6. Repairs and maintenance, including supplies.

Each of these quantities directly affects the total power cost and should, therefore, be considered in a comparison of costs.

Fixed Charges.—The actual percentage to be used for fixed charges has always been the cause of considerable discussion. A number of the oil-engine manufacturers insist that 10 per cent is sufficient. In one cost comparison an oil-engine manufacturer used 14 per cent. In another case a manufacturer used 16 per cent. Regardless of the correct percentages to use for the items of interest, depreciation, taxes and insurance, management today will seldom accept a fixed charge of less than 15 per cent. An inspection of reports submitted to industrial concerns by competent consulting engineers will show that in cases where new equipment was considered a fixed charge of 15 per cent was commonly used in the cost computation.

Business concerns not subject to regulation by law, as are our public utilities, will ordinarily require that any investment made in plant equipment must be returned in not more than five years. This means that an annual obsolescence charge of 17.7 per cent of the initial investment must be set up. From an engineering standpoint a depreciation charge based on the useful life of the equipment is probably correct, but present-day business economics will not permit this method of calculating overhead charges. When taxes and insurance charges are added to the obsolescence



RELATION BETWEEN LOAD AND PLANT FACTORS AND FUEL OIL CONSUMPTION

charge, it is apparent that the annual fixed charges will be approximately 20 per cent.

To be conservative, fixed charges of 15 per cent have been used in the costs exhibited in Tables III and IV. In this connection it must be pointed out that the use of 15 per cent as the amount of fixed charges takes into consideration the setting up of a reserve fund for depreciation, on which an interest rate of 6 per cent is assumed to be earned.

WIDE VARIATION IN COSTS

There seems to be a wide variation in the installation costs of Diesel engine plants. From available data the investment costs range from as low as $120 per kilowatt up to as high as $210 per kilowatt, exclusive of building and real estate. Whenever power costs are to be determined for a new installation, all of the individual items that comprise the total investment should be considered. In most cases it will be found that the total investment, exclusive of building, for oil-engine plants ranging in size from 100 kw. to 300 kw. will be at least $160 per kilowatt. For larger plants ranging in size from 500 kw. to 1,500 kw. the investment will be approximately $150 per kilowatt.

TABLE I — FUEL AND LUBRICATING OIL CONSUMPTION AND MAINTENANCE COSTS OF DIESEL OIL ENGINES IN SERVICE

Reference	Years Data Covers	Installation	B.t.u. Per Lb. of Fuel	Average Annual Output, Kw.-Hr.	Peak Load, Kw.	Annual Load Factor, Per Cent	Lb. of Fuel Per Kw.-Hr.	Kw.-Hr. Per Gal. of Lubricants	Mtce. Cost, Including Supplies, Etc., Mills Per Kw.-Hr.
A	4	Three 500-hp. Diesels	19,000	6,172,050	1,140	62	0.680	1,070	3.80
A	4	Four 225-hp. Diesels							
		One 500-hp. Diesel	19,000	2,379,750	740	36.7	0.890	480	6.83
A	4	Three 225-hp. Diesels	19,000	1,172,930	500	26.8	0.955	472	10.21
A	4	One 500-hp. Diesel							
		Two 225-hp. Diesels							
		One 170-hp. Diesel	19,000	2,209,520	660	38.3	0.814	550	8.59
A	4	One 500-hp. Diesel	19,000	1,935,600	350	63.2	0.745	1,160	4.70
B	6	Three 500-hp. Diesels		5,833,230	....	66.5*	0.680	....	4.45
B	1	Two Diesels, total 340 hp.		563,685	....	28.2*	0.807	895	....
B	1	Two Diesels, total 530 hp.		778,310	....	25.0*	0.860	845	....
B	1	Three Diesels, total 980 hp.		1,514,862	....	26.3*	0.786	673	2.66
B	1	One 165-hp. Diesel		680,293	....	70.8*	0.745	....	1.05
B	1	Four Diesels, total 2,000 hp.		6,331,937	....	53.6*	0.715	898	2.62
B	1	Three Diesels, total 1,500 hp.		3,959,033	....	45.3*	0.783	....	4.75
C	4 mos.	Three 350-hp. Diesels		798,400	....	39.1*	0.683	801	....
D	1	Two 2,000-hp. Diesels							
		Two 1,250-hp. Diesels	18,450	18,465,720	3,200	65.8	0.703	3,030	1.54
D	1	Two 2,000-hp. Diesels							
		Four 1,250-hp. Diesels	18,450	20,700,500	3,500	67.5	0.752	2,700	1.64
D	1	Five 225-hp. Diesels							
		One 750-hp. Diesel	18,650	2,246,680	949	27.1	0.896	600	6.05
D	1	Two 240-hp. Diesels							
		One 520-hp. Diesel	19,250	2,130,540	625	38.9	0.750	572	4.72
E	8	Three 500-hp. Diesels		6,670,000	....	80.0*	....	....	2.25
E-C	1	Three 225-hp. Diesels		1,516,000	....	41.7*	0.715†	....	5.5
F	1	One 150-hp. Diesel	19,000	134,616	86	19.1	1.38	....	0.6
K	1	Four 500-hp. Diesels		6,438,326	....	59.0*	0.70†	900	2.62
L	1	Three Diesels, total 980 hp.		1,250,764	....	23.1*	....	....	2.8
M	1	Two Diesels, total 345 hp.		581,590	....	30.2*	0.795†	980	0.2
N	1	Three Diesels, total 1,562 hp.		1,162,518	....	13.3*	0.93†	668	0.64
Total		75 engines, 38,847 hp.		95,626,854 kw.-hr.					
Average (arithmetical) for 24 plants							0.808	1,018	3.72

*Station capacity load factor. †Assuming fuel oil weighs 7.5 lb. per gallon.

References:
"A" —1925 Report of Sub-Committee on Diesel Engines of Great Lakes Division, N.E.L.A., page 9.
"B" —1925 Report of Sub-Committee on Diesel Engines of Great Lakes Division, N.E.L.A., page 11.
"C" —1925 Report of Sub-Committee on Diesel Engines of Great Lakes Division, N.E.L.A., page 10.
"D" —Table II, page 2 of Serial Report of Prime Movers Committee on Oil and Gas Engines, Maren, 1925.
"E" —Figure 2, page 3 of Serial Report of Prime Movers Committee on Oil and Gas Engines, March, 1925.
"E-C" —Taken from operator's records.
"F" —Taken from operator's records.
"K" —ELECTRICAL WORLD, April 1, 1922.
"L" —*Power*, May 24, 1921.
"M" —*Power*, July 24, 1923.
"N" —*Power*, November 23, 1926.

TABLE II — FUEL AND LUBRICATING OIL CONSUMPTION AND MAINTENANCE COSTS OF DIESEL ENGINE PLANTS (LISTED IN REPORT ON HEAVY-OIL ENGINE WORKING COSTS (1924–25) OF DIESEL ENGINE USERS ASSOCIATION OF ENGLAND)

Reference No. of Plant	Years Data Covers	Installation: No. of Engines	Installation: Total Kw. Installed	Average Annual Output, Kw.-Hr.	Peak Load Kw.	Annual Load, Factor, Per Cent	Lb. of Fuel per Kw.-Hr.	Kw.-Hr. Per Gal. of Lubricants	Mtce. Cost, Including Supplies, Mills Per Kw.-Hr.
1	3	2	325	1,305,300	....	....	0.683	667	2.18
2	3	3	366	1,053,000	200	60.1	0.658	1,430	1.12
3	3	1	90	249,686	90	31.7	0.851	746	8.40
4	3	3	1,830	3,845,690	1,675	26.2	0.726	575	2.78
5	3	3	670	1,103,242	625	20.2	0.702	970	2.42
6	3	4	588	726,801	425	19.5	0.847	500	3.50
7	3	3	250	460,736	90	58.4	0.727	1,190	2.00
9	3	3	1,125	1,783,278	840	24.2	0.721	1,205	0.40
10	2	2	500	772,830	375	23.6	0.761	348	2.82
11	3	6	1,985	2,159,488	1,325	18.6	0.738	553	2.36
13	3	3	600	813,088	500	18.5	0.662	715	3.20
14	3	5	710	927,441	448	23.6	0.813	1,515	3.06
15	3	4	615	574,339	410	16.0	0.712	1,235	1.20
16*	1	19	3,225	3,980,490	2,290	19.8	0.804	935	4.12
17	3	4	575	478,767	296	18.5	0.695	637	2.62
18	2	1	295	335,631	232	16.5	0.860	460	1.06
19	3	7	2,300	2,592,940	1,889	15.7	0.740	271	5.42
20	3	4	495	524,992	364	16.5	0.658	770	1.22
21	3	5	317	325,840	168	22.1	0.822	476	1.86
22	3	4	2,580	2,670,510	1,940	15.7	0.731	740	3.38
23	3	4	890	864,860	820	12.1	0.752	753	4.00
24	3	2	357	335,787	310	12.4	0.676	800	4.38
25	3	3	465	416,832	355	13.5	0.774	432	6.08
26	3	5	533	454,304	308	16.9	0.638	863	6.42
27	3	3	900	684,270	595	13.1	0.953	388	5.60
28	3	4	740	469,413	515	10.4	0.782	740	5.18
30	2	2	270	156,922	108	16.6	0.723	455	7.00
31	2	1	75	38,387	50	8.8	0.692	247	9.96
32	3	6	1,080	1,562,038	811	22.0	0.741	455	6.68
39	3	8	2,290	4,806,971	1,644	33.4	0.758	637	1.28
40	3	7	1,792	3,452,804	1,164	33.9	0.688	417	2.16
42	2	3	440	604,892	260	26.6	0.987	305	8.30
43	3	8	2,310	2,672,362	800	38.1	0.757	407	2.92
†	7	3	789	1,366,823	666	23.4	0.730	445	4.42
Total		145	32,372	44,570,754					
Average (arithmetical) for 34 plants							0.752	685	3.81

*Summary of five (5) plants. †Page 17, Report on Heavy-Oil Engine Working Costs (1923–24), Diesel Engine Usare Association.

NOTE: Output, peak load and load factor are for year 1924–25 only. Average age of engines 8.3 years. Auxiliaries require approximately 2.4 per cent of energy generated. Twenty-five per cent of capacity listed in table was installed during year of report. B.t.u. of fuel approximately 19,000 to 19,500.

In determining the initial cost for a particular plant the various items comprising the total investment should be carefully estimated and the above figures used as a check.

Attendance Labor. — The amount of attendance labor required in an oil-engine plant has also been a debatable question. From the opinions voiced by the managers and superintendents of a number of plants where oil-engine generating units are used it is evidently essential that a capable operating engineer be employed, even though the installation consists of but one unit. The experience of these plants shows that where incompetent labor is hired to operate the engines the maintenance costs are extremely high.

In small plants, where only two units are installed, one man is required per shift. If the units are operated ten hours per day, only one man is necessary. If the units are operated from sixteen to twenty-four hours per day, at least two men will be required for the operation of the plant.

LABOR WITH THREE OR FOUR UNITS

In larger plants, consisting of three or four units, having a total installed engine capacity of more than 1,000 brake horsepower, two men will be required for each shift. A chief engineer is an absolute necessity in plants of this size, although in many instances he may take the place of one of the shift engineers. The operating engineer in charge of each shift should be competent and well qualified to operate an oil-engine plant. It will be necessary to pay such a man at least 75 cents per hour; helpers can be secured for approximately 55 cents per hour. These rates vary, depending on location.

Fuel Oil Consumption.— From Tables I and II it will be found that the fuel oil consumption for the 56 plants which are reported varies from 0.638 lb. per kilowatt-hour to 1.38 lb. per kilowatt-hour. The median value is

TABLE III—COSTS OF DIESEL ENGINE POWER FOR 100-KW. LOAD
(80 Per Cent Power Factor)

Units required: two 156-kva. generators, connected to 200-hp. engines.
Total minimum cost, installed complete, $40,000.

	Kilowatt-Hours Per Month		
	20,000	40,000	60,000
Fixed charges at 15 per cent	$500.00	$500.00	$500.00
Labor, one man	190.00	.....	.....
Labor, two men	.....	340.00	340.00
Fuel oil at 6 cents per gallon	120.00	224.00	336.00
Lubricants at 60 cents per gallon	15.00	19.80	30.00
Water at 6 cents per 100 cu.ft.	12.00	24.00	36.00
Maintenance	65.00	90.00	135.00
Total monthly cost	$902.00	$1,197.00	$1,377.00
Cost per kilowatt-hour, cents	4.51	2.99	2.29

0.745 lb. per kilowatt-hour. An inspection of the chart prepared from the data in these two tables shows that load factor has but little influence on the fuel consumption. For load factors less than 50 per cent a fuel consumption of 0.75 lb. per kilowatt-hour is lower than the average. For load factors above 50 per cent a fuel consumption of 0.70 lb. per kilowatt-hour represents a fair average. These values are used in the preparation of Tables III and IV.

In the cost computations used in this report, a price of fuel oil of 6 cents per gallon is used, and a weight of 7.5 lb. per gallon is assumed. The price will vary according to the locality and also according to market fluctuations. The chart showing the posted prices of Appalachian crude oil indicates the wide fluctuations that take place in the oil market. This is one disadvantage of using oil, even where the cost of fuel is a comparatively small item of the total cost.

Cooling Water and Maintenance Costs Often Unavailable

Lubricating Oil Consumption.—From Tables I and II it is found that the average lubricating oil consumption for the 51 plants reporting this item is 796 kw.-hr. per gallon. The median value is 673 kw.-hr. per gallon. There is an extremely wide variation in the lubricating oil consumption of the plants listed in this table, the variation being from 247 to 3,030 kw.-hr. per gallon. This variation is probably partly due to a difference in quality of the lubricating oils. The chart showing the data on lubricants indicates that load factor has very little influence on lubricant consumption for load factors below 50 per cent.

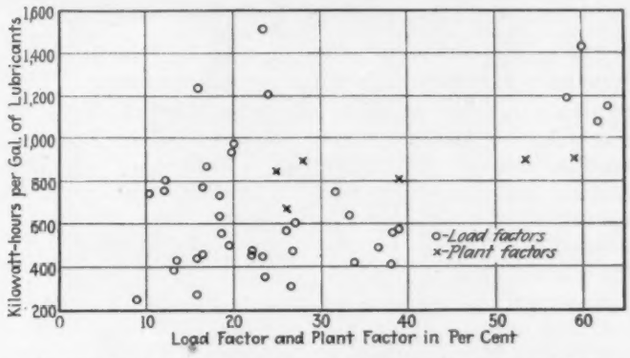
The average lubricating oil consumption for those plants having load factors less than 50 per cent is 656 kw.-hr. per gallon. The median value is 637 kw.-hr. per gallon. For load factors above 50 per cent the median value is approximately 1,190 kw.-hr. per gallon of lubricants.

TABLE IV—COSTS OF DIESEL ENGINE POWER FOR 500-KW. LOAD
(90 Per Cent Power Factor)

Units required: three 300-kva. generators, connected to 400-hp. engines.
Total minimum cost, installed complete, $108,000.

	Kilowatt-Hours per Month		
	100,000	200,000	300,000
Fixed charges at 15 per cent	$1,350.00	$1,350.00	$1,350.00
Labor, two men	340.00	.....	.....
Labor, four men	.....	680.00	680.00
Fuel oil at 6 cents per gallon	600.00	1,120.00	1,680.00
Lubricants at 60 cents per gallon	75.00	100.00	150.00
Water at 6 cents per 100 cu.ft.	60.00	120.00	180.00
Maintenance	325.00	450.00	676.00
Total monthly cost	$2,750.00	$3,820.00	$4,715.00
Cost per kilowatt-hour, cents	2.75	1.91	1.57

In determining power costs, lubricating oil consumptions have been used of 800 kw.-hr. per gallon for load factors less than 50 per cent and 1,200 kw.-hr. per gallon for load factors greater than 50 per cent. Comparing these with the average results obtained by the plants in the table, it is apparent that these figures



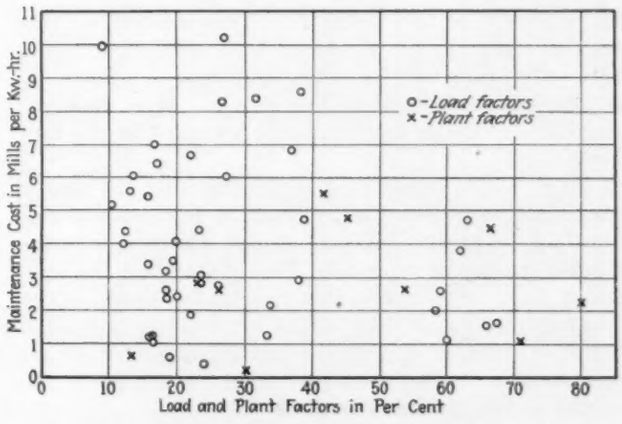
EFFECT OF LOAD AND PLANT FACTORS ON LUBRICATING OIL CONSUMPTION PER KILOWATT-HOUR

represent a considerably better performance than is usually obtained.

Cooling Water.—The cooling water consumption will depend upon the inlet and outlet temperatures maintained. An average of 1 cu.ft. of cooling water will be required for each kilowatt-hour generated. When the cost of the water is known, it is then possible to determine the amount of this item.

Maintenance.—In the cost figures submitted by some engine manufacturers, the item of maintenance is frequently missing. When it does appear, it is often an extremely low figure, although one case is known where a manufacturer used a figure of 5 per cent of the initial investment as the annual cost of maintenance. A number of the manufacturers use 1½ per cent and 2 per cent of the initial investment in the generating equipment as the amount chargeable for maintenance on their equipment.

There seems to be no real justification for charging



RELATION BETWEEN LOAD AND PLANT FACTORS AND MAINTENANCE COSTS

for maintenance on the basis of a certain percentage of the initial cost of the generating equipment. It is quite evident that the annual maintenance cost for a unit operating 24 hours a day will be considerably in excess of the cost of a unit operating only ten hours per day at the same load. For this reason the maintenance cost

will be more nearly proportional to the output in kilowatt-hours.

From Tables I and II an average cost of maintenance of 3.78 mills per kilowatt-hour is obtained for the 55 plants reporting this item. The median value is 3.06 mills per kilowatt-hour.

Consideration of Load Factor

The average for the plants having load factors less than 50 per cent is 4.12 mills per kilowatt-hour. The median value is 3.50 mills per kilowatt-hour. For the plants having load factors in excess of 50 per cent the average value is 2.52 mills per kilowatt-hour and the median value is 2.25 mills per kilowatt-hour. On account of the large number of plants taken into consideration, these figures represent a dependable basis for estimates.

In Tables III and IV a maintenance cost of 3.25 mills has been used for load factors of less than 50 per cent. For load factors in excess of 50 per cent a maintenance cost of 2.25 mills per kilowatt-hour has been used. One manufacturer states that "the maintenance cost of a Diesel engine is about the same per unit of power generated regardless of the size of the plant."

Supervision.—Each department of a manufacturing plant is chargeable with a certain percentage of supervision overhead. The operation of an oil-engine plant will require a certain amount of some executive's time and therefore should be charged for this supervision. Since this item varies with different concerns, no attempt has been made to evaluate it. It is, however, a legitimate charge and should be included in the total power costs.

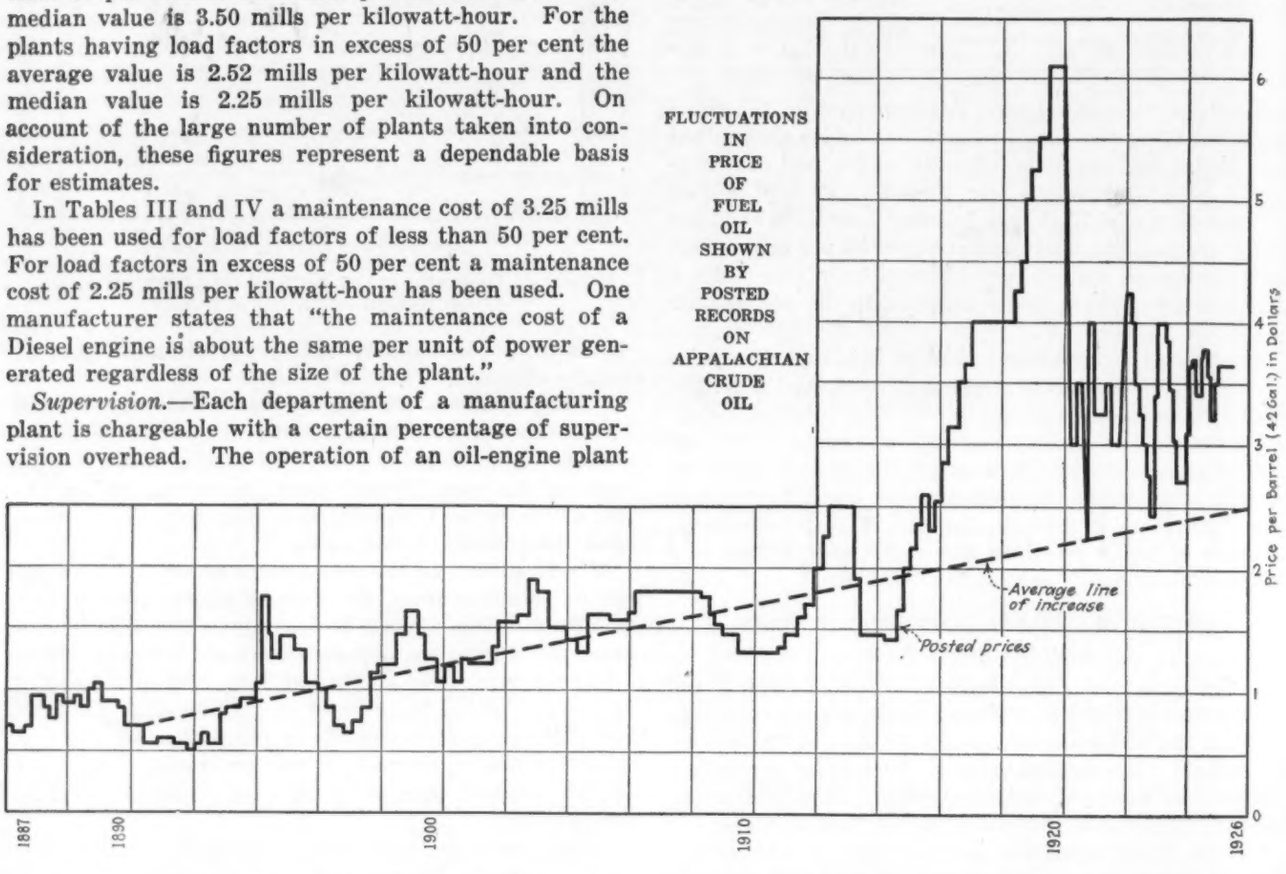
Size of Units Required.—In determining the size of generating units required it must be remembered that according to accepted Diesel engine practice, all sizes of units are maximum rated. This means that the units do not have any appreciable overload capacity. One manufacturer states that "slight overloading is possible at the expense of higher operating costs, but is not recommended." The capacity of an oil engine is also reduced as the altitude increases.

Factors Determining Rating of Units Which Should Be Used

Since the oil engine has little or no overload capacity, the capacity of the unit should be at least equal to the maximum load the engine will be required to carry. This will ordinarily mean that the capacity of the unit should be approximately 20 per cent greater than the fifteen-minute integrated maximum demand. If allowance is to be made for additional future load, then the unit size should be made a larger proportion of the total rating.

In order to insure continuity of service, it is necessary to install at least two generating units. In large plants, as in the case of the one considered in Table IV, two units can be used to carry the normal load, with one unit as a spare.

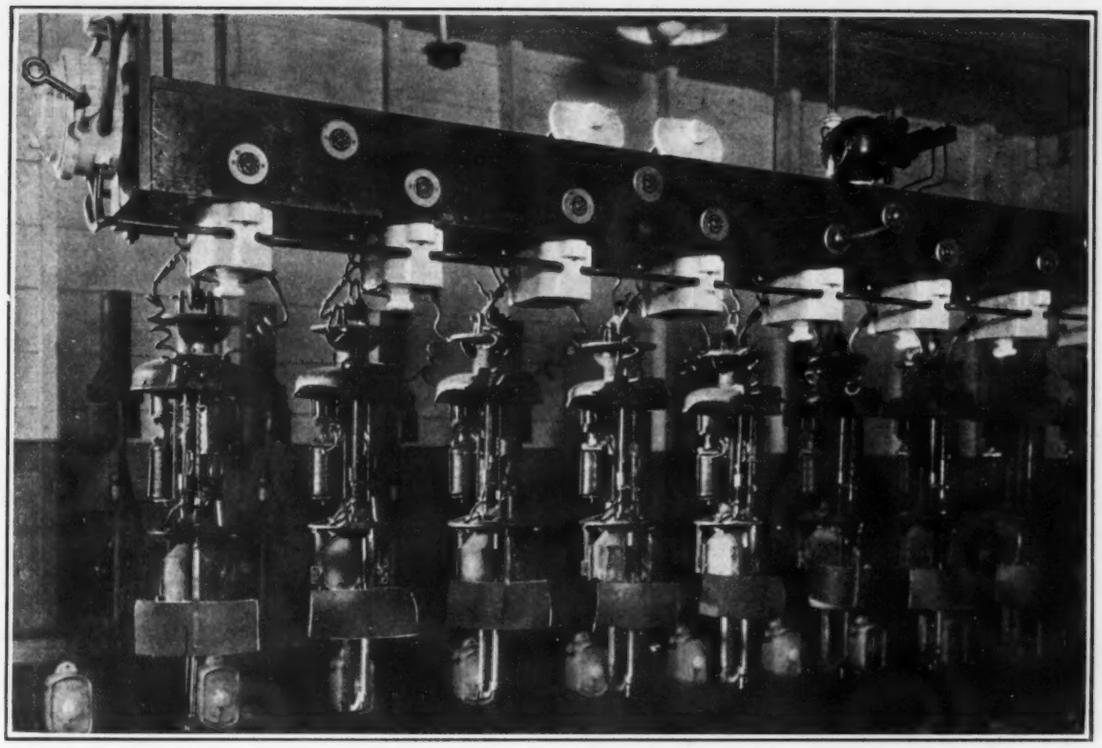
Total Power Costs.—Tables III and IV give the total costs of generating power with Diesel engines for loads having maximum fifteen-minute demands of 100 kw. and of 500 kw.



From Table III it can be seen that total power costs for a 100-kw. load will vary from 2.29 cents to 4.51 cents per kilowatt-hour, depending upon the monthly output. For the 500-kw. load the cost per kilowatt-hour will vary from 1.57 cents to 2.75 cents, depending on the monthly output.

These costs, it must be remembered, are based on conservative estimates and therefore represent lower than average results. The initial investment required has been taken at a low figure. Fixed charges have been taken at a minimum and the allowance for labor has been reasonable. Fuel and lubricating oil consumptions and maintenance costs are lower than the average. Accordingly it can be expected that, on the average, the actual costs for Diesel power will exceed the figures arrived at in the tables.

From the data contained in this report it is a comparatively easy matter to determine the costs of furnishing power with Diesel oil engines. When the unit costs for fuel oil, lubricants, water and labor are known, a table can be prepared similar to Tables III and IV for the power load and output under consideration.



Arc-Lamp Maintenance at Worcester

Methods of Shop Inspection and Testing Provide for Safe and Rapid Work —Maintenance Routine Is Explained—Comprehensive Outline Provided of the Procedure Followed in Repairing Faults

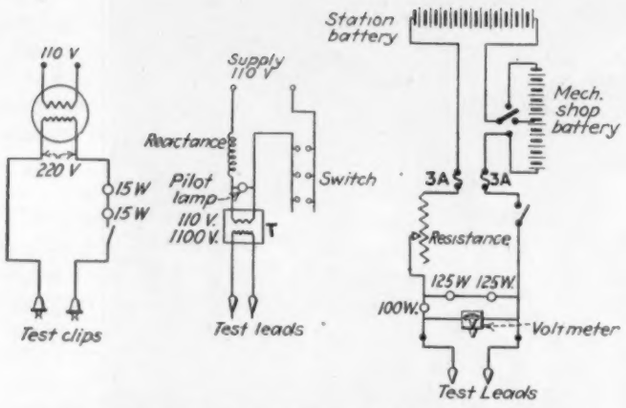
SYSTEMATIC maintenance of arc lamps by the Worcester (Mass.) Electric Light Company centers at the Faraday Street service station, where a repair shop area of about 1,250 sq.ft. is available for this work. At present 1,263 Form 3 General Electric pendent type 4-amp. arcs are in service on the principal streets outside the business district, and the downtown section is provided with 1,050 Form 10 General Electric 6.6-amp. ornamental arcs. Two men handle the entire shop repairs on these and a few other arc lamps used in special locations, each man normally working every other week on arc-lamp maintenance. The Form 3 lamps burn 4,000 hours per year; about two-thirds of the Form 10 lamps burn all night regularly and the remainder are on a dusk-to-midnight schedule. Lamps are shopped only upon receipt of corresponding trouble reports from service. Minor repairs in the field are made by trimmer-inspectors. Each man trims on an average 75 lamps a day.

All arc lamp repairing is in charge of a foreman, who is also responsible for the general condition of arc lamps on the system. If an arc lamp is brought in showing evidence of lack of care or improper handling, such as defective upper electrodes, bent or broken mechanical parts, etc., the foreman notes the location and reports the fact to the company's service engineer. If the condition becomes general, a report is made to the company's general superintendent for appropriate action.

The shop equipment is compactly arranged, the major facilities being a repair bench 14 ft. long by 4 ft. wide by 34 in. high, with compartment drawers to hold tools and lamp parts of smaller size; a floor rack for storing 24 ornamental type lamps; an overhead storage rack holding fifteen 4-amp. lamps; an overhead test rack with a capacity of ten 4-amp. lamps, and a floor test rack with a capacity of sixteen ornamental type lamps. In laying out this shop it was desirable to avoid loss of time in walking from one point of inspection and test to another, one man being scheduled to handle all normal tasks. The repair bench and racks were therefore placed in parallel and from 6 to 10 ft. apart, with an outer passageway at each end. Special attention has been paid to safety engineering in this shop in view of its compactness and the test voltage requirements involved. Reference to these features will be made later.

Maintenance Routine

All new arc lamps intended for street lighting are given a company number as soon as received at the shop, the numbers being stamped on brass tags and attached as follows: On Form 3, 4-amp. pendent type lamps, tags are held in place by the suspension cap set screw; on Form 6, 6.6-amp. pendent type lamps, tags are fastened to the resistance cover with a 10/32-in. machine screw, a hole being drilled and tapped for this purpose, and on Form 10, ornamental type lamps, the tags are held in

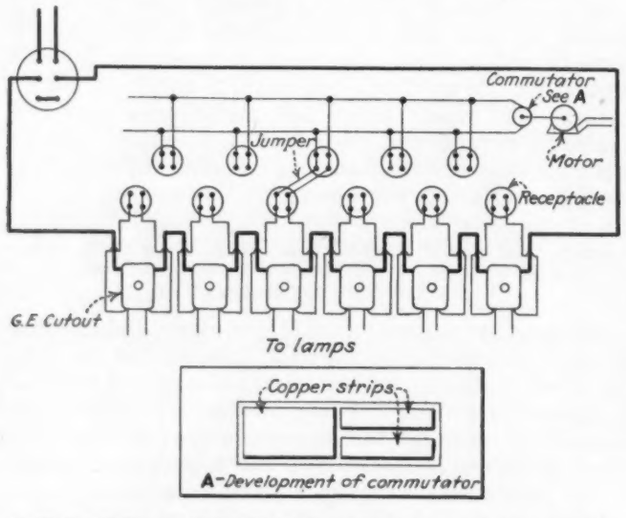


WIRING FOR OPEN-CIRCUIT TEST, FOR FRAME-CONTACT TEST AND SUPPLY-VOLTAGE TEST

place by one of the screws used to hold the lower support for the starting magnet.

For each new lamp the lamp repair man or some one designated by the foreman fills out a record card bearing the company number and serial number of the lamp. These cards are filed numerically and are kept in the repair shop. When a lamp is placed in service, the date, location, company number and name of installer are entered in a book kept at the shop and also on the card. The location is obtained from the man taking out the lamp if the shop is open, and if closed, information is obtained from slips recording each arc lamp changed made out by the man taking out the lamp. When a lamp is brought in from service, the date and the name of the man returning it are entered in the record book and card above mentioned. If the records show that the lamp has not been continuously in service for a period of more than one month, the full routine of repairing is not required. Each new lamp is tested and adjusted if necessary before going into service.

To save time and labor, lamps are repaired in groups of eight Form 3's and six Form 10's simultaneously. On the lamps as a whole and on parts each operation required is performed on every lamp in the group before the next operation is begun. One side of the main repair bench is assigned to each ampere rating of



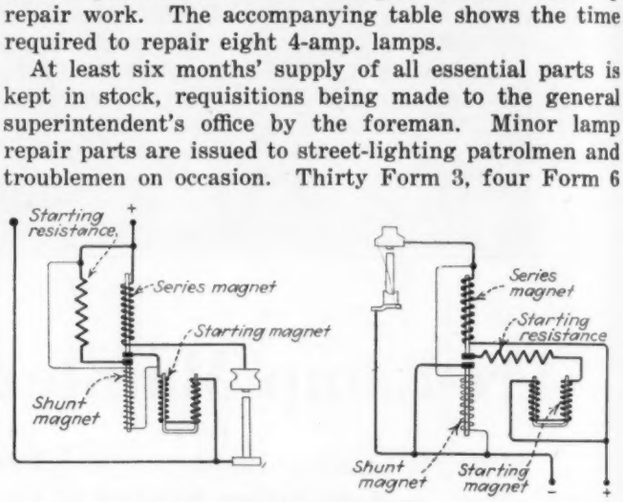
MOTOR-DRIVEN SHORT-CIRCUITING SCHEME USED IN TESTING FORM 3 LAMPS

TIME REQUIRED TO REPAIR EIGHT 4-AMP. LAMPS

	Minutes
Repair or replace cables	13
Locate faults	6
Remove and polish clutch rods	11
Remove mechanism	11
Remove grounds, replace worn or broken parts	53 to 109
Clean and repair mechanism	14
Assemble mechanism	19
Replace, if necessary, top electrodes	13
Assemble clutch and align lower electrodes	23
Polish company numbers	14
Attend to record	7
Time for eight lamps (typical group)	3 hr. 4 min. to 4 hr.

lamps. In this way confusion is avoided and the work progresses steadily without delays due to injecting varied operations at different stages of individual lamp repair work. The accompanying table shows the time required to repair eight 4-amp. lamps.

At least six months' supply of all essential parts is kept in stock, requisitions being made to the general superintendent's office by the foreman. Minor lamp repair parts are issued to street-lighting patrolmen and troublemen on occasion. Thirty Form 3, four Form 6



CIRCUITS OF FORMS 3, 6 AND 10 ARC LAMPS RATED AT 4, 6.6, AND 6.6 AMP. RESPECTIVELY

and 34 Form 10 lamps are kept ready for use, hung in an accessible place and properly grouped.

After all repairs and adjustments have been made, lamps are given a trial run of at least fifteen minutes on the type of circuit for which they are rated. Test current is supplied on request by the substation operator from a regular rectifier set. Not less than nine 6.6-amp. lamps are tested, and during this run each lamp is started at least ten times. Full-length lower electrodes are used and left in the lamps after the run. Special colored goggles are worn when working about the lamps during this test, great care being exercised to avoid coming in contact with live parts.

TEST SCHEDULES

Tests of Form 3 lamps for open and short circuits are made by the apparatus illustrated in the accompanying diagram. It consists of a 220-volt supply with two 110-volt, 15-watt lamps in series and one or more pairs of test terminals which are applied to the lamp leads.

(a) With cut-out contacts together in the lamp and electrodes apart, the test lamps burn brightly under normal conditions, the circuit through the starting resistance and starting magnets being closed. If the lamps burn dimly, there is an open circuit in the starting resistance or cut-out contact circuit. The test lamps do not burn at all when there is an open in the starting magnet circuit.

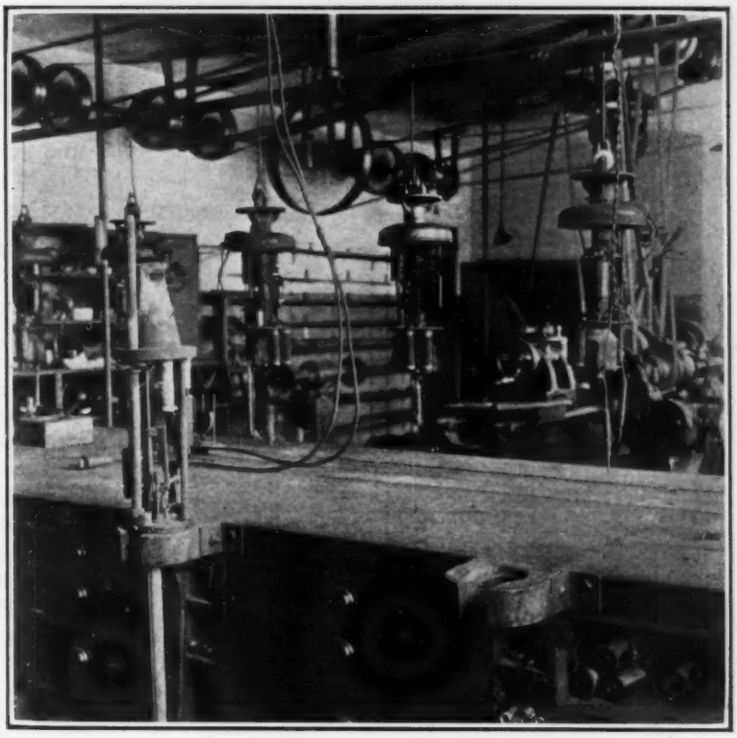
(b) With conditions as in (a) and the test lamps burning brightly, the maintainer separates the cut-out con-

tacts by lifting the upper one with an insulated tool. Under normal conditions with the shunt magnet circuit closed the test lamps burn dimly; these burn brightly in case of a short circuit in the shunt magnet or across the arc, and if the shunt magnet circuit is open, the lamps do not burn at all.

(c) With conditions as in (b) and the test lamps burning dimly, the electrodes are brought together. Normally the test lamps then burn brightly, the circuit being closed through the series magnet and electrodes. If the last-named circuit is open, the lamps burn dimly.

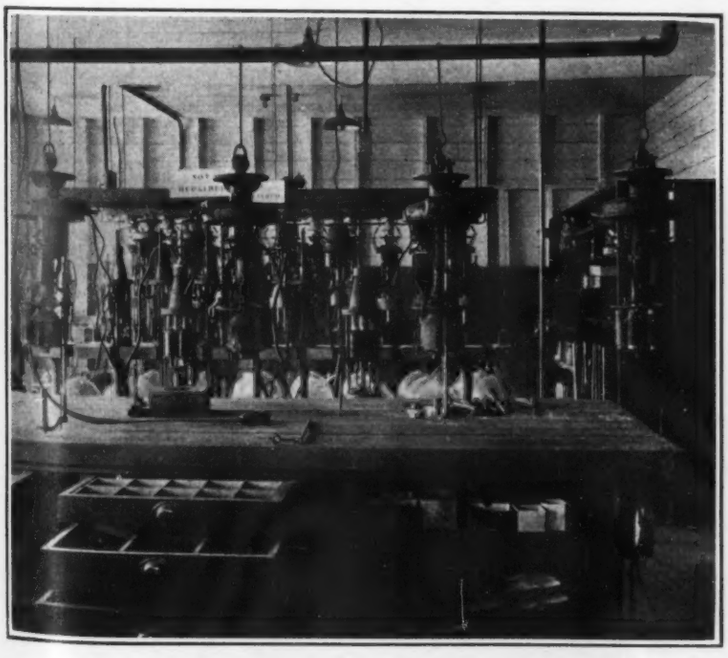
Tests for frame connections are made by the apparatus illustrated in the accompanying drawing. There is a 110-volt supply, switch, series reactance, pilot lamp and a 1-to-10 transformer supplying approximately 1,100 volts at the test terminals. The switch is so constructed that it may be used in connection with any one of the special sockets provided, and it requires constant pressure from the finger to hold it in the closed position. In making this test the switch cable is inserted in one of several special receptacles above the aisle and the apparatus is tested by closing the switch with the test leads not in contact. When this is done, the pilot lamp should burn. The switch is then released and one of the test leads connected to one of the lamp leads, the other test lead being connected to the frame at some suitable point, such as beneath the nameplate. The switch is then closed. If the pilot lamp burns, there is no frame connection; if it burns dimly or not at all, a frame connection exists.

The exact location of the frame connection or contact may usually be determined by observation, as the majority of such faults are heated when the test current passes through them and smoke issues. If the fault does not smoke after the test current has been applied for two minutes, the various parts of the lamp are disconnected and tested separately.



TEST BENCH FOR 6.6-AMP. LAMPS

Wooden sockets 6¾ in. long, 6¾ in. wide and 2¾ in. thick, with recess to hold the lamp under test, are conveniently used and are attached to the bench by angle-irons. Flexible lead cable from the test lamp is housed in special compartments in the bench between the drawers as shown.



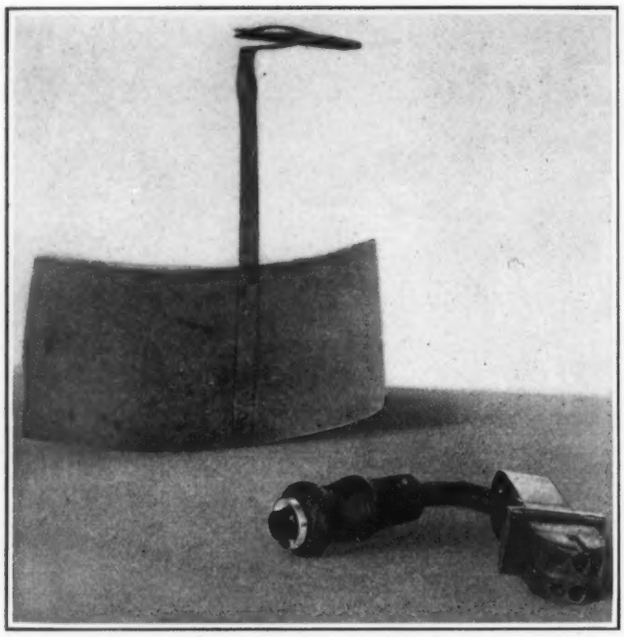
TEST BENCH FOR 4-AMP. UNITS

Lamps are supported by hooks from pipe rail above; compartment drawers are used for storing supplies

Tests of the voltage at which lamps will feed are made by the apparatus shown herewith. This consists of a connection to the substation battery with several cells in addition located in the arc lamp repair shop and used as end cells, a variable resistance in series with the supply, a lamp resistance connected as shown and a voltmeter. The test shows the exact voltage at which the shunt coil will bring the electrodes together. To make the test the series magnet armature is held in the raised position by a special spring and the leads from the test apparatus are connected to the lamp leads. Starting with all the resistance cut in, the voltage is gradually raised by cutting out resistance, meanwhile watching the voltmeter. At the instant that the shunt magnet raises the armature, the voltage drops about 30 per cent.

Faults are noted on the arc-lamp record card previously referred to. This is a 3x5-in. card, with the lamp number stamped upon it and records inscribed by hand.

In general, any open circuits discovered by one of the foregoing tests are required to be closed before proceeding with the next test. An open may frequently be traced to a particular section of a circuit by short-circuiting each section in turn with a piece of wire. The section in which the test produces normal conditions is open circuited. The section is al-



ASBESTOS EYE SHIELD AND PUSH-BUTTON CONTROL

Shield consists of 3¾ x 9¼-in. red fiber mounted on spring-clip holder; push button and plug is used for control of transformer low-tension primary circuit in testing for grounds on frames.

lowed to remain short circuited until the tests are completed. If it should be necessary to short circuit the shunt winding, test (c) cannot be performed and the series coil and electrode circuits must be tested directly for opens by disconnecting them and applying the test terminals directly to each. If the test lamps light, the circuit is closed.

The next step in maintaining Form 3 lamps is the removal and cleaning of the trip rod, movable clutch rod and short guide rod. The dashpot and armature of the starting magnet are then removed, cleaned and repaired. The guide tube and clutches are then removed, the parts being cleaned and renewed when necessary. The long guide rod and connecting parts are examined, cleaned and renewed if required. The copper connecting cable on the long guide rod is coiled loose enough to allow free play for the movable clutch rod throughout the entire length of its travel and tight enough to avoid contact with the frame. Guide tube and clutches are next replaced and the upper electrodes removed. The cut-out contacts are cleaned and renewed and adjusted to proper separation by gage. Parts are replaced and adjusted and electrical tests made as above stated. Black paint is applied to the upper casting and the casing and globe are put on.

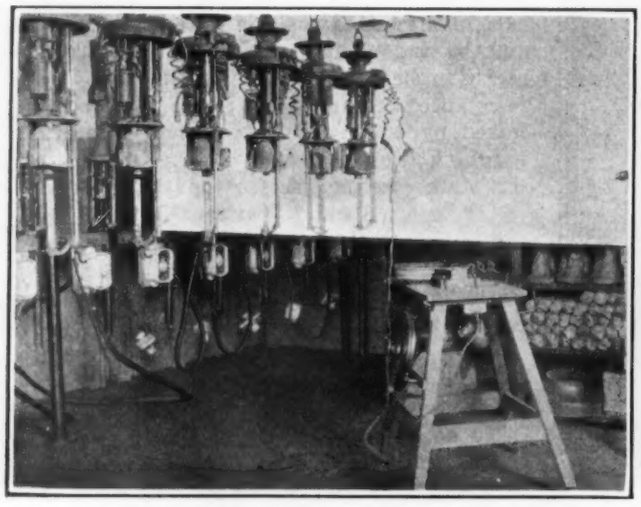
ROUTINE THAT IS FOLLOWED IN HANDLING FORM 10 LAMP

In repairing Form 10 arc lamps, tests for opens, shorts and frame contacts (faults) are made as with the Form 3 lamps with the exceptions which are noted in the following:

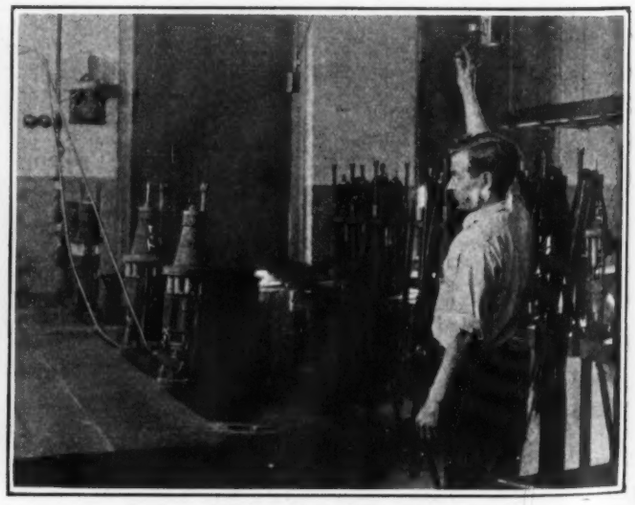
In test (a) if the test lamps burn dimly, the open circuit may be in either the starting magnet, starting resistance or cut-out contacts, and if they do not burn at all, the open circuit must be closed before proceeding with the next test. In test (b) if the test lamps do not burn at all, there is an open circuit in either the series or shunt magnet windings. In test (c) if the test lamps do not burn brightly, the open is in the electrode circuit. Parts are removed, repaired and replaced according to a stated order as covered in detailed loose-leaf instructions issued by the company, and the final test with regular line current of specified voltage completes the task.

To safeguard shop testing the section devoted to this work is reserved and is not open to employees in general. The 1,100-volt test is controlled by a push-button type of plug switch, which must be inserted in an overhead receptacle before this potential can be applied to the test clip. The maintainer cannot push the test button in the primary circuit of the test transformer unless he is clear of the lamp, as shown in the accompanying illustration, and as soon as the finger is removed from the button the transformer circuit is broken. Eye shields, one of which is shown in the accompanying illustration, are provided in testing lamps for normal operation before the globes are attached.

The average labor and material cost of repairing arc lamps in 1926 was $3.32 per lamp changed. The total number of lamps which were changed amounted to something over 1,700 units.



PORTABLE VOLTMETER STAND USED IN TESTING FOR FEED VOLTAGE



PUSH-BUTTON CONTROL KEEPS TEST MAN CLEAR OF 1,100 VOLTS USED TO TEST FRAME CONTACTS

Serving a Medium-Voltage A.C. Network

Load Areas Served by Ideal Layout of Substations and Feeders —Reduction of Copper and Copper Losses Obtained— Simple Switching Arrangements

By D. K. BLAKE
General Electric Company, Schenectady, N. Y.

AN ELECTRIC system may be divided conveniently into generation, transmission, transformation and distribution. This is virtually a four-link chain illustrating the equal importance of each division. No division should be planned and designed without a thorough consideration of the others. Some of the major technical problems now encountered in planning a system are large short-circuit currents, complicated relaying, voltage regulation, load growth and standardization of practice and equipment. A theoretical study was made to determine an ideal system that would solve these problems. The main features of this ideal system are submitted in this article to promote further study along these lines.

The ideal alternating-current distribution system is a network that permits loads to be tapped at any point and permits the addition of supply feeders at various points, which are determined by the distribution of the load. Studies made by some engineers indicate that polyphase low voltage (115-230 volts or 120/208 volts) secondary networks are economical for areas of high load densities. This is particularly true where the network transformers are supplied direct from primary circuits of the generated voltage (13,200 volts) or the transmission voltage (26,400 volts). The intermediate transformer substations are omitted. Quite a few engineers believe this type of system is the ultimate ideal. It certainly does simplify considerably the installation and operation, although certain new problems of no small importance are introduced. Accepting the conclusions that this secondary network constitutes the ultimate ideal, what is the ideal transmission and distribution system to supply the city until the high load density is reached? Studies made of a 4,000-volt (or 4,600-volt) network give results sufficiently encouraging to submit for discussion and further investigation.

Economic studies made by engineers of some operating companies indicate that substations from 10,000 to 20,000 kva. are most economical for load densities of 1,000 kva. per square mile to 10,000 kva. per square mile. Suppose the standard size of substation chosen is 15,000 kva. The equipment consists of four cables and four transformer banks, with one cable and transformer considered a spare. At an average density of 1,000 kva. per square mile the substation would supply an area of 16 square miles, as indicated in Fig. 1. In Fig. 2 is shown the same area supplied by four 5,000-kva. substations feeding into a portion of the 4,000-volt network. For the same number of circuits the same load is carried with a reduction of 16.7 per cent in distribution feeder copper and 67 per cent in copper losses. The regulation of the longest feeders is reduced from 9.6 per cent to 1.92 per cent at 0.8 power factor. The distance to the feeding points is equal in the latter arrangement, thereby permitting group regulation or possibly the regulation of the entire sys-

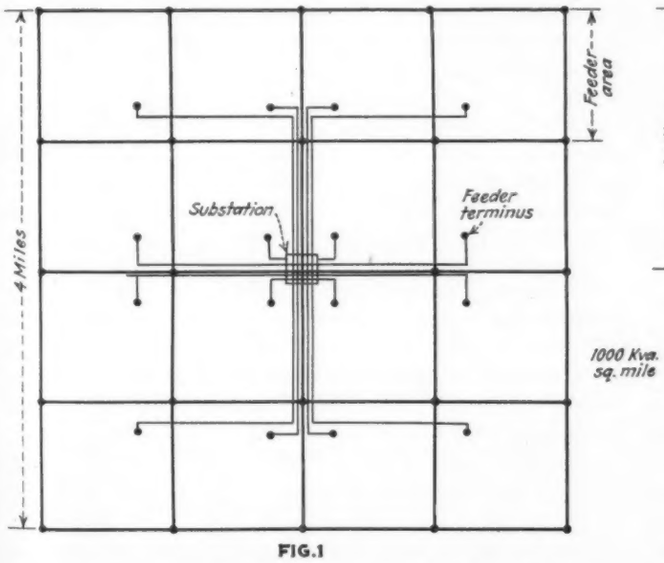


FIG. 1

FIG. 1—USUAL LAYOUT FOR LOAD DENSITY OF 1,000 KVA. PER SQUARE MILE USING ONE 15,000-KVA. SUBSTATION

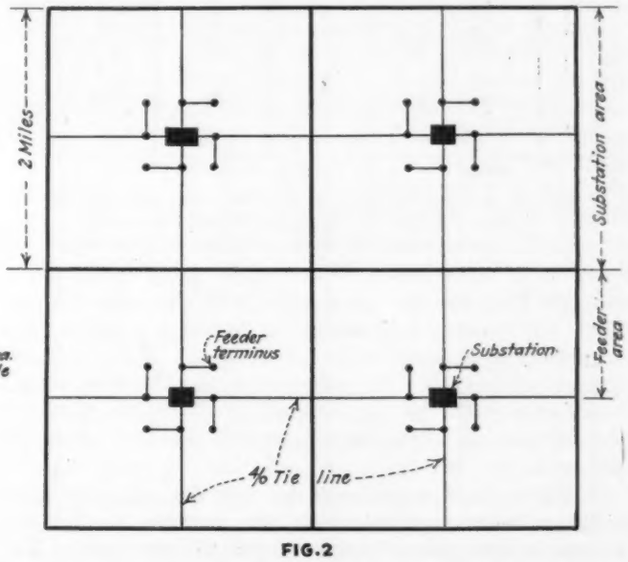


FIG. 2

FIG. 2—NEW LAYOUT FOR 1,000-KVA. LOAD DENSITY USING FOUR 5,000-KVA. SUBSTATIONS SAVES COPPER AND COPPER LOSSES

tem by the generators. The length of transmission circuit is the same provided the generating station is not located so as to permit a straight run to the 15,000-kva. substation. In such cases the length of transmission feeder in the area per transformer may be increased 50 per cent, or four miles for four transformers. For such load densities it is expected that overhead construction would be used.

When the load density has increased to 4,000 kva. per square mile, the 15,000-kva. substation supplies an area of four square miles (Fig. 3). The small substations supply an area of one square mile and are spaced one mile apart (Fig. 4). With the network it is unnecessary to remove any feeder copper to decrease the area supplied by a substation. The feeder copper for the network arrangement is reduced 25 per cent. The feeder copper losses are reduced 50 per cent. The regulation of the longest feeder is reduced from 7.35 per cent to 1.92 per cent at 0.8 power factor. The maximum short circuit is 132,000 kva. for the large substation and

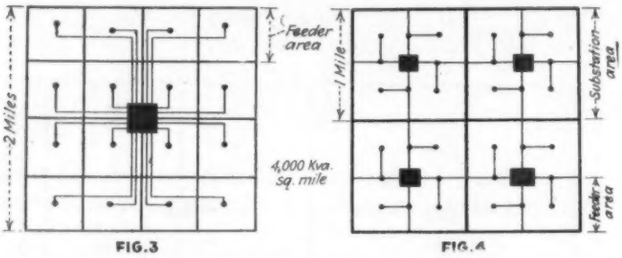


FIG. 3 FIG. 4

FIGS. 3 AND 4—METHOD OF SERVING LOAD DENSITY OF 4,000-KVA. PER SQUARE MILE WITH ONE LARGE SUBSTATION OR FOUR SMALLER ONES

100,000 kva, for the network. With the network the duty on a network breaker is 83,500 kva. and on a transformer breaker it is 66,000 kva. When a short circuit occurs on a 4,000-volt feeder, the 15,000-kva. load is affected with the big substation. With the network the voltage on adjacent substations remains above 82 per cent.

When a fault occurs on the interior of a network midway between substations, the voltage on the two adjacent substations stays above 67 per cent. The next substations beyond stay above 85 per cent. A short circuit on the outer edge of the network midway between two substations will not pull down the voltage of one below 55.5 per cent and the other 70 per cent. When the substations are two miles apart these values are 67.5 per cent and 71 per cent respectively. It is therefore evident that a fault on the network does not disturb voltage conditions very far from the point of trouble.

The switching arrangement of the network is shown in Fig. 5. Each substation consists of five 4-kv. oil circuit breakers and one 5,000-kva., three-phase transformer. No high-voltage switching is necessary at the substation. The adjacent substations may be supplied from different bus sections. The loss of a bus section, feeder breaker reactor, feeder cable and transformer will not interrupt service to a substation. The full load 0.8 power factor regulation to the feeder load centers on the loss of supply to a substation is 9.43 per cent with two-mile spacing and 5.66 per cent with one-mile spacing. A fault on a 4-kv. feeder interrupts twice as much load as in the pure radial practice.

All feeder breakers are provided with inverse time limit overload relays. Every relay is adjusted with the same setting. The transformer breaker is provided with reverse power protection in addition to the inverse time limit overload relays. The feeder breakers at the generating station are provided with inverse time limit overload relays. A fault at any point on the system is cleared in the minimum possible time. Graded relay settings are unnecessary. The breakers are provided

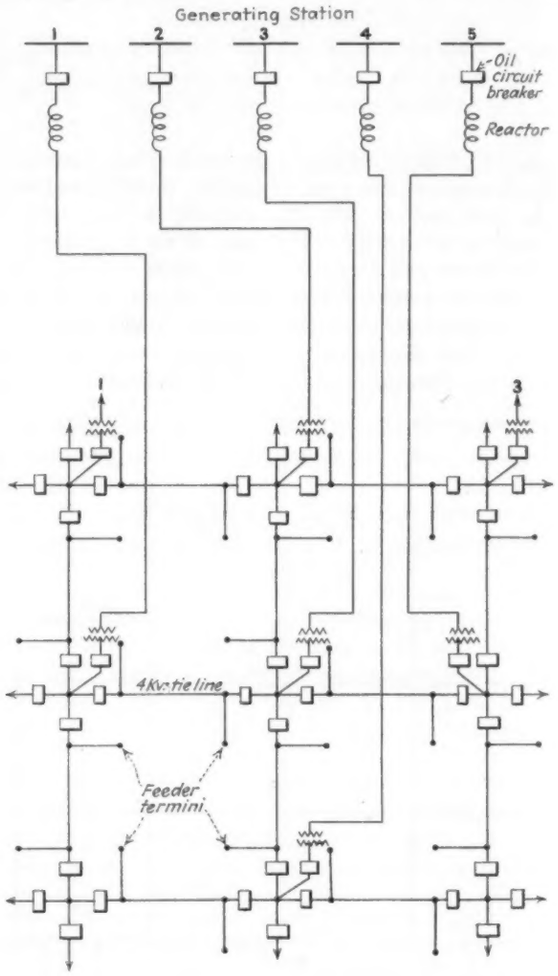


FIG. 5—SWITCHING ARRANGEMENT FOR NETWORK

with automatic reclosing features which greatly improve service by quickly restoring service in the cases (approximately 75 per cent of the total) where the fault is not permanent. The network fits in well with sectionalizing to restore service on the primary main sections not in trouble.

With the network the only variation in impedance between the feeder load center and the generating station is the transmission feeder. This variation is small compared with the total. It seems that the generators should be able to regulate the entire system. If not, regulators could be used in the transmission circuit at the generating station or transformer secondary at the substation.

The transmission system short-circuit currents and the extent of the resulting voltage disturbance are limited by the feeder reactors and the 5,000-kva. transformers. If the size of breaker is determined by the reactor, then it need not exceed 200,000-kva. interrupting capacity. Otherwise the size is determined by the

generator capacity connected to a bus section. If the large 15,000-kva. substation does not have a high-voltage bus, then the 4-kv. bus voltage will not fall below 67 per cent when a fault occurs on a transmission feeder. With the network this value is 44.5 per cent on a two-mile spacing and 61.5 per cent on a one-mile spacing. The voltage on the adjacent stations drops to about 91 per cent with either spacing.

Such a system permits a high degree of standardization of equipment and practice. Every substation consists of a 5,000-kva., three-phase transformer and five truck-type panels. (A double bus seems unnecessary, as a bus failure is cleared by the breakers. Service to the feeders is restored automatically. Standardized trucks permit quick and economical replacement of a damaged truck equipment.) The reduction in price because of standardization should be given consideration in comparing the cost of the network system.

The 4,000-volt network is also suitable to higher load densities such as 10,000 kva. per square mile. In this case an additional transformer and feeder truck panels could be added. The maximum short-circuit current would increase to about 135,000 kva.

At 4,000 kva. per square mile it is probable that the low-voltage secondary network is more economical than increasing the capacity of the 4,000-volt network. The transformers on the 4,000-volt feeders could be connected into a secondary network. As the load continues to grow 13,200-volt feeders could supply the network without the use of substations. The existing 4,000-volt network could be continued the rest of its useful life or utilized to supply loads unsuitable for a secondary network.

The foregoing analysis is by no means complete. A serious problem introduced by the 4-kv. network is the real estate problem. The topography and industries of a city may preclude such a system. If all the claims made for the network are valid, there is still the problem of applying it economically to an existing system. It is believed that the possibilities indicated by analysis of the system warrant submitting it for discussion and study.

London Gas Works Produce Electricity

AT THE Beckton works of the Gas Light & Coke Company, London, electricity is now being produced as a byproduct of gas manufacture. The process consists of taking heat from burnt producer gases which are exhausted into the atmosphere and using it to raise steam. The steam power so obtained is used to generate electricity at a power house in the works. In this way energy which would otherwise be wasted is made available for service. The Beckton gas works are, it is said, the largest in the world. They produce annually 20,000,000 cu.ft. of gas, involving the treatment of 1,000,000 tons of coal and approximately 800,000 gal. of oil.

After twelve months' operation the scheme by which waste heat is utilized as electricity has proved extremely useful, and an additional 2,500-kw. generating set for the power house has been ordered from the Metropolitan Vickers Electrical Company, which supplied the original equipment. When the present extensions are completed the generating station will be capable of producing power sufficient to drive motors totaling well over 6,000 hp.

Capacitors Save Cost First Year

Relative Costs Involved in Installing Various Apparatus for Power Factor Improvement in a Factory, Giving Specific Figures Based on an Actual Case

BY H. M. JALONACK
Central Station Department General Electric Company

"IF THE power factor of the customer's load is brought within 5 per cent of unity, there will be no reduction on the first 30,000 kw.-hr., but there will be a reduction of two mills on the next 70,000 kw.-hr. and three mills on any further kilowatt-hours."

This clause, which summarizes the conditions relating to the improvement in power factor in the power contract submitted by one central station to its industrial customers, caused one of the latter to consider power factor correction. The plant had a very high load factor and used a large amount of energy, and good results were therefore expected.

CONDITIONS IN CASE ANALYZED

The power consumption was about constant and for several observed months the average quantity consumed was 1,032,000 kw.-hr. per month. Without correction and based on a charge of 1½ cents per kilowatt-hour the monthly bill was $15,480. With correction, the first 30,000 kw.-hr. would be billed at 1½ cents, or $450, the 70,000 kw.-hr. at 1⅓ cents, which would be $910, and the remaining 932,000 kw.-hr. at 1⅙ cents, which would be $11,184. This gives a total bill of $12,544. The monthly saving is thus $2,936 and yearly saving $35,232.

The average load in this plant was 1,652 kw., the load factor being 68.5 and the power factor 63 per cent. At 63 per cent, this made the total kilovolt-amperage 2,622 and the reactive kilovolt-amperage 2,036. At 95 per cent power factor and with the same kilowatts, the total kilovolt-amperage would be 1,739 and the reactive 543. It was therefore necessary to supply for correction the difference between these two reactive kilovolt-amperages, or 1,493 kva. Although the customer actually purchased, when the transaction was completed, a total of 1,800 kva., the figures given below are based on the actual required kilovolt-ampere in every case, the basis being 1,500 kva. in equipment.

There were three propositions to be considered: First, the installation of synchronous condensers; second, the replacing of a large quantity of the present induction motors with synchronous motors designed for power factor correction; third, the installation of capacitors.

SYNCHRONOUS CONDENSERS

The use of two 750-kva. synchronous condensers was considered, each of these synchronous condensers rated 440 volts, three phase, 60 cycle, 1,200 r.p.m., with a direct-connected exciter, auto-transformer, necessary rheostats and panels, at a selling price of $4,778, or $9,556 for the two. Adding an installation cost of $1,500 makes the price installed $11,056.

The total losses in the two equipments were 72 kw. The losses in the corresponding capacitor equipment were 3.75 kw., making a difference of 68.25 kw. between the losses of the two schemes. The customer estimated that they operated the plant 700 hours per month, or 8,400 hours per year, making a total of 575,300 kw.-hr.

a year difference in losses between the synchronous condensers and the capacitors. At 1⅞ cents per kilowatt-hour, this made the difference in operating cost $6,905. This customer figures the carrying charges, including interest, depreciation and repairs, at 20 per cent, which, although higher than used by most customers, is probably made necessary by the amount of dust and dirt flying in the air, necessitating increased maintenance, and also the continuous duty cycle, which is rather hard on all kinds of apparatus. Based on this 20 per cent carrying charge, the capital value of the losses would be five times $6,905, or $34,525. Adding to this the price of the synchronous condensers of $11,056 made a total for Proposition "A" of $45,580.

SYNCHRONOUS MOTORS

The following motors with their reactive kilovolt-amperages are the ones that were to be taken out and replaced with 80 per cent leading power factor motors:

Present [Induction] Motors			Reactive Kva. Eliminated
No.	Hp.	R.p.m.	
3	75	720	94
6	50	720	122
3	75	1,200	71
3	100	900	109
1	100	720	43
2	100	1,200	92
1	200	720	93
1	75	900	30
1	100	900	36

This makes a total of 1,725 hp., which, disregarding for the time being the correction beyond unity, would eliminate a total of 690 kva. reactive. The amount of corrective kilovolt-amperage figures out 777, and this, in addition to the 690 kva. eliminated by taking out the induction motors, gave 1,467 kva. correction, which is approximately that necessary to bring the power factor to 95 per cent. The total cost of the new synchronous motors was estimated to be about $39,000. To this was added an installation cost of $4,000, making a total of $43,000. Assuming that the induction motors taken out could be resold to some second-hand dealer at $2 per kilovolt-ampere, this gave an allowance of $3,500, making a net total cost for the synchronous motors of $39,500. The amount of losses which it was fair to charge to operation of these synchronous motors was the difference between the losses in the motors at 80 per cent power factor and the losses in the induction motors. The total losses in the synchronous motors were estimated as 105.85 kw. and in the induction motors as 93 kw., making a difference of 12.85 kw. Subtracting from this the total losses in the capacitors of 3.75 kw., gave a difference of 9.1. The yearly cost of these losses, based on 8,400 hours and 1⅞ cents per kilowatt-hour, was $920, and capitalized at 20 per cent, gave a capital value of $4,600. This $4,600, added to the cost of the synchronous motors as given above, made the total cost of the synchronous motor scheme $44,100.

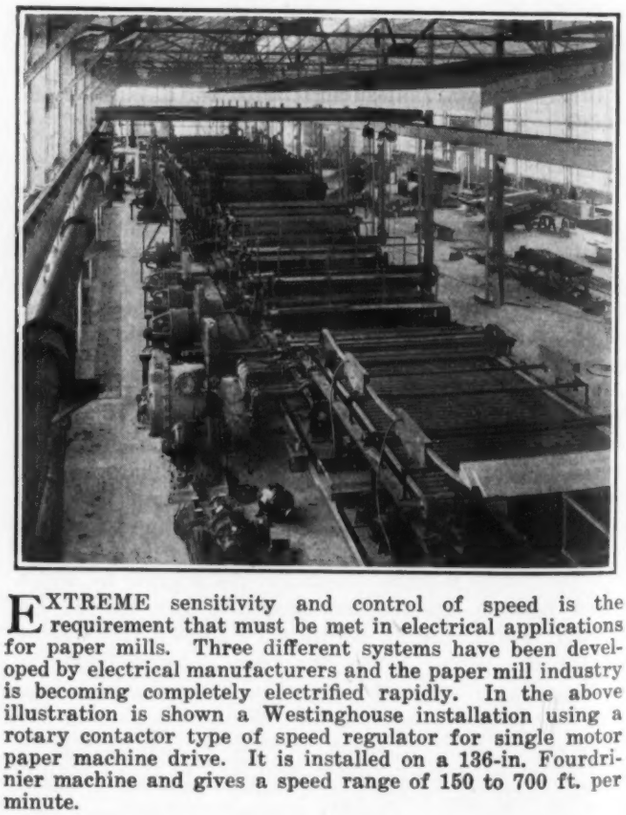
USE OF CAPACITORS

The capacitors considered for this installation were those designed for direct connection on 440 volts, 60 cycles, and were complete with capacitor units, racks, screens, discharge coils and oil circuit breakers. The total price for the five 300-kva. equipments to make up the 1,500 kva. required was $27,240, to which was added an installation cost of $2,000, making a total of $29,240. The capitalized cost of the losses is not added to this figure, of course, since, in the two other cases, the difference between these losses and the losses of the proposed arrangement only were taken.

It is obvious from the above that the capacitor installation was by far the most desirable and the cheapest arrangement from all points of view. Both of the other proposed schemes required the use of revolving parts with commutators and slip rings. In a plant of this kind, where there is dust and dirt, the operation of such devices is rather questionable where the customer has had no experience with commutators to know what might be expected. The operation of the capacitor equipments is, of course, very much simpler than that of rotating machinery such as synchronous condensers. In connection with the synchronous motors, one of the disadvantages of this scheme was the fact that the customer would have to be out of service on at least part of his equipment in order to install the motors. This meant, in view of the customer's continuous duty cycle, a considerable loss in manufacturing and therefore in money. The capacitor equipments, on the other hand, could be all installed and it would only take a very short time to connect them on the line when everything was ready for them.

Because of the fact that the five 300-kva. equipments would just bring the power factor to the desired amount and any increase in load would bring it down below the requirement of the central station, it was decided to put in six 300-kva. equipments. This makes a total of 1,800 kva. in capacitor equipments, which is the largest total kilovolt-amperage installed in any industrial plant in the country for direct connection on 440 volts. An interesting feature of the installation is that the total cost of the capacitor equipments will be saved in about the first year of operation.

Electricity in Paper Mills



EXTREME sensitivity and control of speed is the requirement that must be met in electrical applications for paper mills. Three different systems have been developed by electrical manufacturers and the paper mill industry is becoming completely electrified rapidly. In the above illustration is shown a Westinghouse installation using a rotary contactor type of speed regulator for single motor paper machine drive. It is installed on a 136-in. Fourdrinier machine and gives a speed range of 150 to 700 ft. per minute.

Letters from Our Readers

Chicago-Boston Parallel Connection

To the Editor of the ELECTRICAL WORLD:

We have had many inquiries regarding the parallel connection which we arranged between Chicago and Boston, as briefly outlined in your issue for Nov. 27, 1926. We note that you likewise have had some inquiries on this subject, as we have had letters from people who have been referred to us by you. Hence we feel that some further information on this subject would be welcomed by your readers.

On Nov. 18 the writer, together with a number of our engineers, went to Piney on a general inspection trip, intending to parallel the West Penn and Penn Public systems for the first time. We found that there were some adjustments necessary to be made, and paralleling was postponed to the following day. We proceeded on the inspection trip to Ridgway, which was also involved in the West Penn-Penn Public connection mentioned above. On our road to Ridgway George S. Humphrey, electrical engineer of the West Penn Power Company, mentioned that it was possible for the Penn Public system, through interconnections that had already been made, to operate in parallel with Boston and that it was everyday practice for West Penn to operate in parallel with Chicago. Consequently, the closing of the switch connecting the West Penn system and the Penn Public system at Piney would parallel Chicago with Boston if the proper connections were arranged previously. That night Mr. Humphrey arranged through E. P. Peck of Utica, N. Y., to have all of the Eastern section in parallel between 11 a.m. and 12 noon the next day. J. E. Thomas, superintendent of operation of the West Penn Power Company, arranged to have parallel connection in the Western section made through to Chicago at the same time.

On the morning of Nov. 19 the West Penn and Penn Public systems were paralleled to check out the new equipment and synchronizing arrangements before 11 a.m. In the meantime the connections were being checked through by the system operators all the way from Chicago to Boston. It was found that a section of line between Fostoria and Shelby, Ohio, was open for some maintenance work, but the Ohio Power Company very kindly took its men off the job and closed up the circuit in order to complete the through connection. At 11:47 a.m. reports had been received from the system operators that all connections to the east and to the west had been completed, and the breaker at Piney connecting the West Penn and Penn Public systems was then closed. This completed the through connection.

There was no disturbance, and it was easy to control the power interchange within close limits. There was no evidence of hunting, in spite of the 33-kv. line between Union City, Warren and Falconer. This was probably due to the slip-type frequency changer in service at Falconer, which acted as a flexible coupling between the Niagara system and the Western section. The frequency changers at Lighthouse Hill are also of the slip type.

A portion of the West Penn system was operating at 66 kv. on the day of the test, but since that time it has been changed to 132 kv., and it now operates at that voltage from Windsor, through Charleroi, Springdale, Kittanning and Piney to Ridgway. Within a short time the 132-kv. service will extend from Ridgway to Warren, and the line between Warren and Falconer will be put in service at 110 kv. There will then be no circuits in the through line operating at less than 66 kv.

The map we have prepared shows only the lines which were used in the through connection and does not show any companies or lines which were operating in parallel with the through lines but did not enter into the through connection. It would be quite a task to learn definitely all of the systems which were in parallel, but, as a rough estimate, we believe that there was approximately 5,000,000 kw. of generating capacity operating in parallel at the time.

J. S. JENKS,
Vice-president,
West Penn Power Company,
Pittsburgh, Pa.

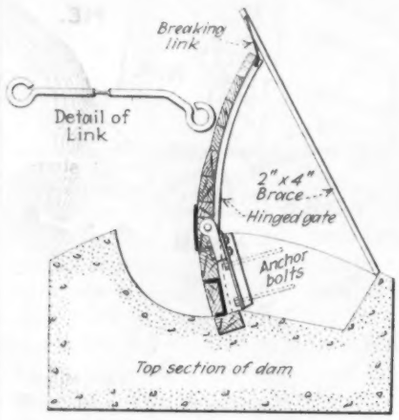
SYSTEM ELEMENTS IN CHICAGO-BOSTON INTERCONNECTION

Central Station and Industrial Practice

Breaking Link to Release Flashboards

BY F. C. SMITH
Production Department Alabama Power Company, Birmingham, Ala.

THE linking device shown in the accompanying illustration has proved a satisfactory means of controlling flood water at one of the Alabama Power Company's small hydroelectric plants. Soon after this plant was purchased and placed in operation it was found the design of the dam permitted of a head 4 ft. higher



FLOOD WATER AT HYDRO PLANT IS CONTROLLED WITH FLASHBOARD USING BREAKING LINKS

than the tops of the flashboards and that this additional head and resultant storage during flood periods offered considerable advantage. The flashboards were originally designed to go down under a head which brought the water about 4 in. over the top, all boards going down at approximately the same time.

A system of bracing with 2x4-in. timbers connected to the gate through breaking links was designed, with the breaking links calculated to allow approximately 4 ft. of water over the gate. These gates are 54 ft. long and have nine ribs on 6-ft. centers, each rib carrying a brace and breaking link. Each of the braces is wired to the dam so that when a link breaks the timber swings to the downstream side of the dam and can be recovered.

By making a slight variation in the strength of the links it is possible to control the sequence of operation, and often one or two openings prove sufficient to release the necessary water. Since, in general, the method of raising boards is none too simple, this scheme saves considerable labor in addition to the gain in plant output.

The link as illustrated is of common round iron and is made in the plant shop by using a gage and file for securing the proper cross-section. The following tests illustrate the uniformity of performance that may be expected from links made in this manner:

Specimen	Maximum Point	Breaking Point
1	3,900	2,750
2	3,800	2,700
3	3,950	2,800

These tests were made on iron filed to ⅛ sq.in. cross-section.

Electrical Control and Protection in a Gasoline-Recovery Plant

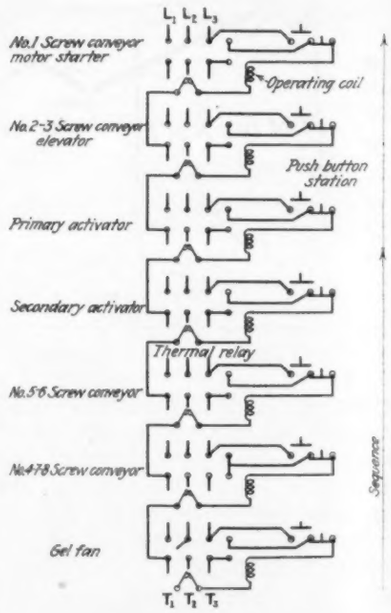
BY A. CHESLEY WILSON
Electrical Engineer the Silica Gel Corporation, Baltimore, Md.

BECAUSE of the exact sequence of motorized operations that must be maintained and protected by the use of various interlocking devices in a gasoline-recovery plant and because the control must be arranged to avoid fire and explosion hazards, the electrical installation of a gasoline-recovery plant of the Interocean Company in Baltimore presents several design features of interest to operators.

In order to provide overload protection for the main line and yet avoid fuses, a magnetic line switch is installed ahead of the bus. A control circuit of the operating coil of this switch has in series with it a small switch operated by a thermal overload relay. The heating elements of this relay are energized from the secondary side of two current transformers inserted in the main line ahead of the magnetic line switch. These transformers were necessary because the main line carries more than 400 amp. per phase and this load is beyond the capacity of any thermal overload relay of which the writer has knowledge.

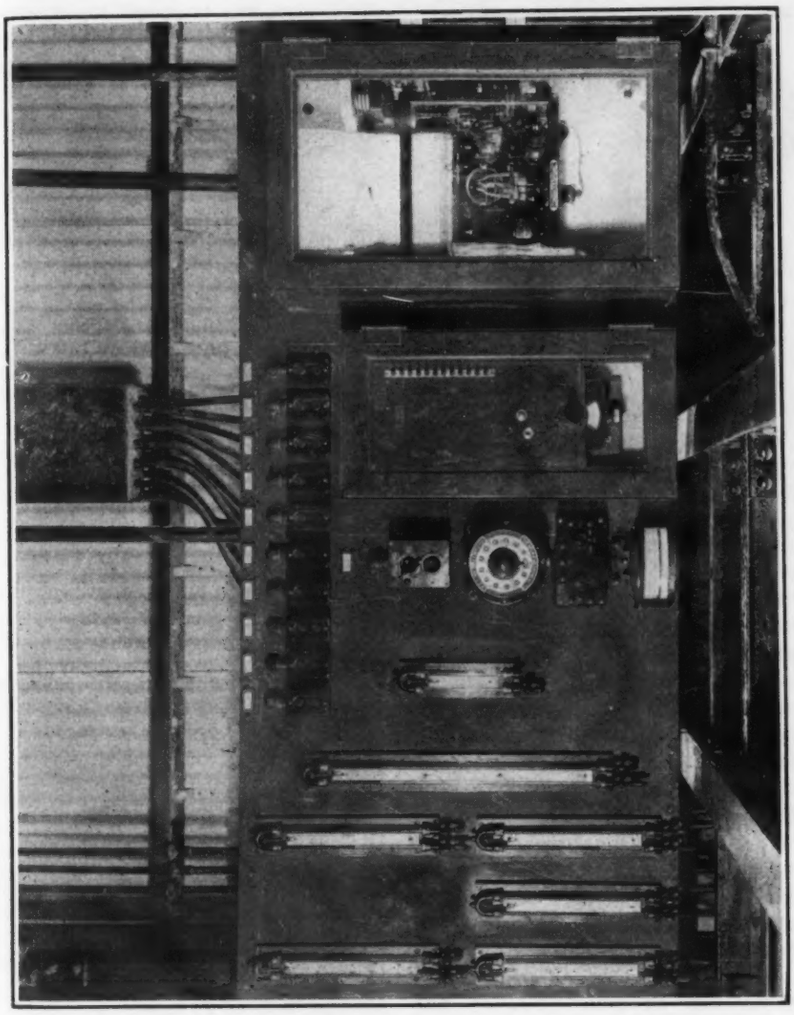
To avoid expensive conduit fittings and facilitate construction work, the bus that supplies the various motor starters is contained in "bus boxes" of pressed steel and with removable fronts. Ample room for making splices and taping joints is thus provided and the danger of injuring insulation when the electrician forces the completed joint back into the usual conduit fitting is eliminated. The three boxes cost $28, whereas conduit fittings at each tap would have cost $36. The greatest gain, however, was due to the ease of making connections, which materially reduced the labor of installation.

From the bus the individual motor circuit goes through unfused



SCHEMATIC OUTLINE OF SEQUENCE OF OPERATION IN GASOLINE-RECOVERY PROCESS

quick-make-and-break disconnecting switches and thence to the magnetic motor starting switches and compen-pensators. Quick-make-and-break switches have been found best, for although the circuit is rarely broken at this point, burnt switch blades have been frequently found in the past due to operators not fully clos-



CONTROL BOARD FOR ELECTRICAL EQUIPMENT OF GASOLINE-RECOVERY PLANT

ing the switch. All motors of 10 hp. or under are thrown directly on the line. The larger motors, with one exception, are controlled by automatic compensators.

The exception mentioned is a motor operated by a compensator, which is of the hand-starting type, as the motor is close at hand and does not need electrical interlocking as do the others.

Each push-button station controlling a motor is in sight of the motor control. Push-button stations, located in the run-down tank room, where explosive vapors may exist, are oil immersed, whereas the corresponding starters are located in a part of the building where there are no vapors.

A stop due to overload or other causes will permit the moving stream of gel* to pile up and cause a jam difficult to clear. To guard against this, the motors driving the various conveying units are electrically interlocked, and when one unit stops, all preceding units of the sequence immediately stop and cannot be restarted until the first unit is running again.

It also follows that this interlocking system makes it impossible to start up the equipment in improper order.

*Pulverized silica gel drops by gravity through ascending gasoline-laden gas, absorbing its gasoline content, and then by means of screw conveyors and an elevator is moved to an equipment that extracts the gasoline from it. By means of other screw conveyors and blowers the gel is returned to the starting point of the cycle and repeats the performance.

Things Not to Do

BY T. G. HIERONYMOUS
Underground Engineer Kansas City Power & Light Company

AT A MEETING of the International Association of Electrical Inspectors held on Jan. 25, 26 and 27, 1927, in Kansas City, Mo., the work of the city electrical inspector was outlined, and among other things mentioned was the requirement of good workmanship on the part of contracting electricians and also the adherence to local and national rules governing such installations. This address brought out very clearly the necessity for good workmanship and the troubles that might ensue due to poor workmanship. As an example of what should be termed poor workmanship and an infringement of the rules of the local power company and the city electrical inspector's office, the accompanying picture is submitted.

Some time in the past an electrical contractor while installing a new service entrance switch for a customer found it necessary to extend the power company's service cable and instead of following the usual practice of requesting the power company to extend its cable, he voluntarily took it upon himself to violate the power company's rules and the city electrical inspector's regulations and spliced out the cable himself.

The service cable consisted of three 4/0 conductors insulated with paper for 600 volts and covered with a lead sheath. The wires used to extend the service cable consisted of three No. 4/0 rubber-insulated, braid-covered wires. The conductor splices were taped over with rubber tape, a piece of iron pipe was slipped over the makeshift joint and the pipe was filled with tar.

How long this makeshift splice held up is not known and its ex-

SECTION OF CABLE AFTER MORE THAN TWELVE YEARS' SERVICE

IRON PIPE USED AS SHEATH IN MAKESHIFT CABLE SPLICE WHICH FAILED

istence was discovered only when it failed. It was necessary for the power company to remove the old cable and install a new one and the customer was without service while this work was being done.

The other illustration shows a section of cable removed a short time ago after having been in service at least twelve years and perhaps as long as 23 years. Accurate records date back twelve years and show no replacement of cable during that time at that location. The first cable was installed in this location in 1903.

Due to the contour of the ground, it was necessary to extend all cables in a conduit line up a steel structure and overhead supported by messengers across several main line railroad tracks and into the wall of a bluff on the other side. This cable was subjected to bombardment by particles of cinders and the sulphur fumes from the stacks on numerous engines and it successfully withstood the action during the time above mentioned. The cable was removed only because it was not required any longer at this location. At no time has any trouble been experienced on this particular section of cable due to the action of the cinders and sulphur smoke, but the illustration shows the condition obtained by such continuous action. This cable is only one of eight, one of which belongs to one of the telegraph companies, and an inspection of the records of that company does not disclose any information relative to trouble, yet none of these cables has any protection.

Inspection and Maintenance of Outdoor Equipment

OPERATING companies are realizing more and more that a definite schedule of equipment inspection must be followed if maintenance costs and service reliability are to be kept where desired. With this in mind, one light and power company has compiled the accompanying inspection schedule covering outdoor substation equipment.

INSPECTION PERIODS FOR OUTDOOR SUBSTATION EQUIPMENT

Substation and Customer Transformers .....Weekly
Temperature of atmosphere, deg. C.
Temperature of each transformer, deg. C.
Temperature rise of each transformer, deg. C.
Height of oil in each transformer.

Electrolytic Lightning Arresters....Weekly
Test of charging current.
Appearance of arc on charging.
Test gap settings, changing if necessary.
Clean off insulators.
Clean and oil operating mechanism.
Inspect ground connections.

Oxide Film Lightning Arresters....Weekly
Test gap settings, changing if necessary.
Clean off insulators, etc.
Inspect fuses.
Inspect ground connections.

Multigap Lightning Arresters .....Weekly
Inspect cylinders and resistance rods, revolving or renewing as necessary.
Inspect ground connections, cleaning if necessary.

Compression Chamber Lightning Arresters .....Weekly
Examine chamber for cracks, etc.
Inspect ground connections.
Clean if necessary.

Ground Tests .....Weekly
Test voltage between each line and ground and across each phase on 2,300-volt side of all distribution substations.

Transformer Substations, Every Two Months
General cleaning and inspection.
Clean gages, thermometers, insulators, transformers, bushings, fuses, switches, etc., oiling disconnecting switches, inspecting fuses, etc.

Transformers .....Every Six Months
Remove top cover plates from transformers and inspect for signs of moisture; inspect bushings and connections and check oil gage level.
Take sample of oil from bottom of transformer and test for breakdown.

Pole-Top Disconnecting Switches.....Every Six Months
Clean and oil pole-top disconnecting switches, all types, paint hardware and examine insulators.

Line Insulators in Substations.....Every Six Months
Clean and inspect line insulators in districts subject to acid and caustic fumes and fertilizer dust.

Oxide Film Lightning Arresters .....Every Six Months
Test cells of oxide film arresters, rebuilding or overhauling as necessary.

Oil Switches and Relays.....Yearly
Inspect 13,000-volt oil switches, removing or changing oil as necessary.
Test overload relays.

Lightning Arrester Grounds .....Yearly
Test resistance of all lightning arrester grounds.

Line Insulator in Substations.....Yearly
Test line insulators for leakage, replacing defective ones.

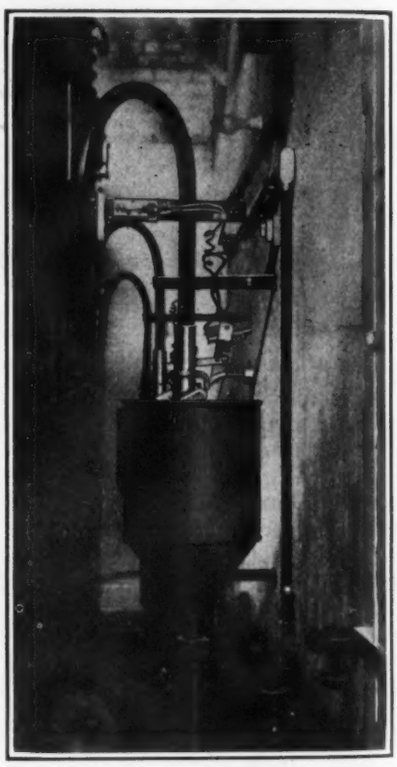
Electrolytic Lightning Arresters .....Every Two Years
Overhaul completely.

Exhaust Relay for Transformer Cooling Water

BY ELLERY R. FOSDICK
Electrical Engineer Washington Water Power Company, Spokane, Wash.

A TRANSFORMER exhaust water relay that is simple, dependable and positive in its action and that has a minimum of small moving parts that are likely to become sluggish in action due to dirt and corrosion has been developed by the writer and is used by the Washington Water Power Company.

The function of this relay is to close a single circuit when there is no exhaust water flowing from the transformer and to maintain an open circuit as long as there is water flowing. A counterweighted water bucket equipped with a mercury tube switch of the single circuit type made by the Cooper Hewitt Company



POSITIVE ACTING TRANSFORMER COOLING WATER RELAY THAT USES MERCURY SWITCH

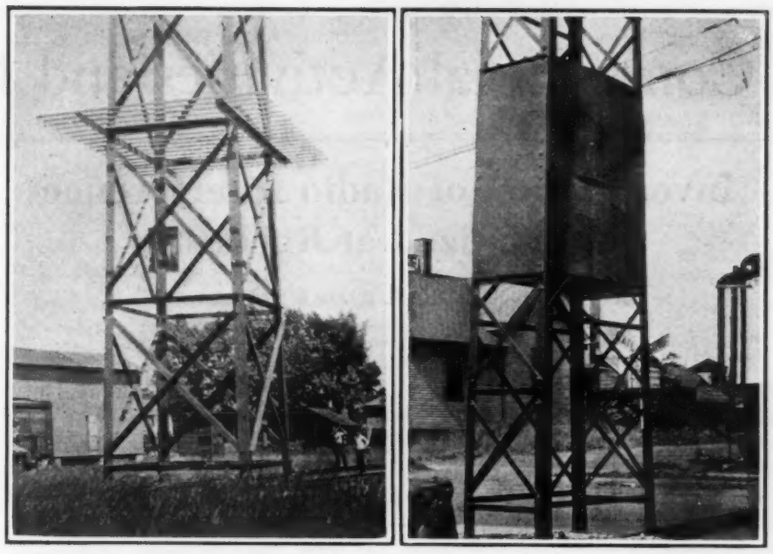
was used. It was found necessary to tilt this tube through a vertical angle of 6 deg. to make or break the circuit. The water bucket was made of No. 22 gage sheet copper and fastened together with copper rivets. All other parts were made of brass except the set screws, which were steel. Since the parts are always somewhat wet due to splashing of the water in the drain pan it was thought

best to make them of non-corrosive material. The mercury tube switch, being completely inclosed, is not affected by moisture.

The action of the relay is very simple. The weight of the water held in the bucket causes the bucket assembly to tilt downward, raising the counterweight and tilting the tube so as to maintain an open circuit. When the water stops flowing or decreases enough so that the bucket will empty through a drain hole placed near the bottom, the counterweight raises the bucket, tilts the tube in the reverse direction so as to close its circuit and give the alarm. The drain hole is of such size that with sufficient quantity of water flowing to cool the transformer the bucket will fill and overflow. Needless to say, this relay is suitable only for indoor use where there is no danger of freezing.

Safety Guards for Exposed Transmission Towers

THE danger to any one but a competent lineman of climbing a steel transmission tower would seem to be obvious, but the experience of the Ohio Public Service Company shows that there are persons who must be protected against themselves. The two illustrations herewith show types of guards the company has erected to prevent unauthorized persons from attempting to climb towers located in particularly exposed places.

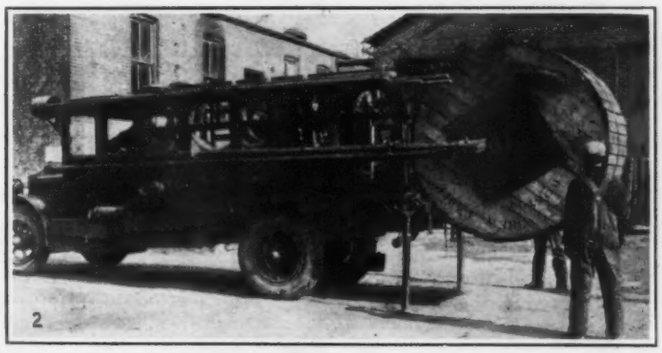


TYPES OF SAFETY GUARDS ON TRANSMISSION TOWERS IN EXPOSED LOCATIONS

At the left is a tower at a railway crossing at Leavittsburg, Ohio. The guard is constructed of 1-in. angle iron on 5-in. centers extending 24 in. beyond the tower.

At the right is another type of guard used at Warren, Ohio, where there was not sufficient clearance to erect a grating platform, so a 5-ft. section of heavy sheet iron was put on. The inside is blocked by 1-in. angle iron. The extra precautions thus taken on towers at railroad crossings are due to a fatal accident which unfortunately befell a watchman who climbed into the high-tension lines.

Mechanical Methods in Line Work Increasing



1. Handling transformer by truck derrick; auxiliary jacks at rear.

2. Lowering cable reel from truck by truck winch.

3. Handling pole by truck derrick.

INCREASING use is being made of mechanical methods in line work on the system of the Connecticut Light & Power Company, Waterbury, Conn. In addition to pole setting, loading cable reels and handling transformers, these trucks save time and labor in stringing wires, loading poles upon dollies at the pole lot, lifting heavy equipment at substations and excavating manholes with the aid of derrick and bucket. Springs, axles and tires are relieved of excessive strains when lifting heavy loads with the derrick by auxiliary jacks mounted under the frame at the rear of the truck body.

Commercial Activities and Public Relations

Investigation of Radio Interference Systematized at Rochester

BY H. J. KLUMB

Assistant Superintendent Electric Meter Department
Rochester Gas & Electric Corporation, Rochester, N. Y.

IN ORDER to expedite action on radio-interference complaints it has been found of advantage by the Rochester Gas & Electric Company to send to each complainant, immediately upon receipt of an interference report, a short questionnaire, which, when properly filled in, frequently provides a reasonably good aid in segregating the type and probable locality of the difficulty. The questions asked are as shown in the following:

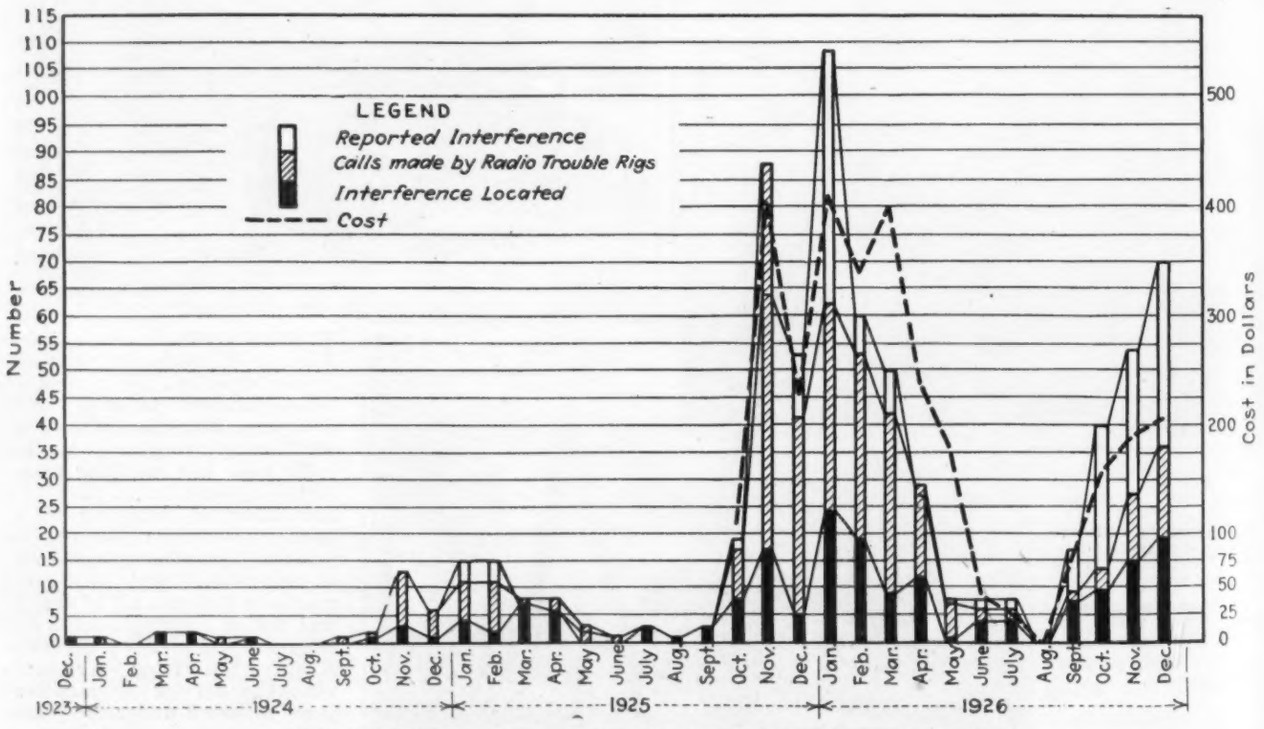
1. Does interference come on and go off with street lights?
2. Describe the nature of sound as well as possible.
3. Is the noise of the same intensity at all points on the dial?
4. Give the call letters of the broadcasting stations near loudest point.
5. Is there any difference in sound when the main house-lighting switch is open?
6. Have you tried turning off any electrical appliances in use in your home while the disturbance is on?
7. If you disconnect your set from the antenna and ground and connect the antenna and ground binding posts on the set together with a piece of wire, does the noise continue?
8. To what cause do you attribute the interference?

It is generally agreed that only a very small percentage of the disturbing noises in radio reception can be attributed to radiation from power lines. During the entire year of 1925 only 50 sources of interference out of 234 investigations conducted by the Rochester company could be attributed to its power lines, and in 1926 only 52 sources out of 291 were similarly reported. The remaining causes of interference located by the investigators were entirely beyond the control of the public utility.

Much of the buzzing noise commonly attributed to power lines originates in loose connections in electrical circuits in the home, in the radio set and battery connections or in various appliances or circuits in which there are arcing contacts. Most of these are located and corrected either by the set owner or by the dealer's service man. Only those located by the company's service men appear on the record, hence the indicated proportion of interference of this type as compared to that actually caused by power lines is not a true picture of the facts.

Reference to the accompanying chart shows that quite a decided peak in complaints was reached in January, 1926, when more than 100 cases of radio interference were reported. Of this number only about 60 could be handled. In many instances the source of disturbance, when located, was found to be common to several complainants, as is indicated in the sharp decline in the number of calls registered for the succeeding months. The continued height of the cost curve for this work in the face of a declining number of interference calls is explained by the prolonged search that extended over a considerable period of time before two particular causes of trouble were finally located.

The purchase of new equipment



NUMBER OF INTERFERENCE COMPLAINTS AND COST OF INVESTIGATIONS

with which to facilitate this service is responsible for the slow descent in the cost curve during the three months April to July, 1926.

Fourteen per cent of the interference reported was found to originate in the radio sets of the complaining "fans," and 7 per cent was chargeable to appliances in their households. Eight per cent of the troubles were traced to industrial or commercial applications. A rough classification of the sources of radio interference located by the company investigators places about one-half on its lines, and of this one-half about 50 per cent is due to street-lighting circuits. The remaining unclassified percentage contained a variety of specific causes, none of which recurred with sufficient regularity to justify a definite separate classification.

This company considers the expense of maintaining such a complete radio-interference service justified to retain the good will of its customers and to promote safety. It has been the experience of many utilities engaged in this work that the rigid inspection of their lines, necessary in many instances to locate and eliminate the source of interference difficulties, has disclosed conditions which if allowed to remain undetected might have resulted in power interruptions and possible mishaps of a serious consequence.

Firing Decorative Glassware with Electric Heat

BY ODIN WILHELMY
Industrial Sales Department Union Gas & Electric Company, Cincinnati, Ohio

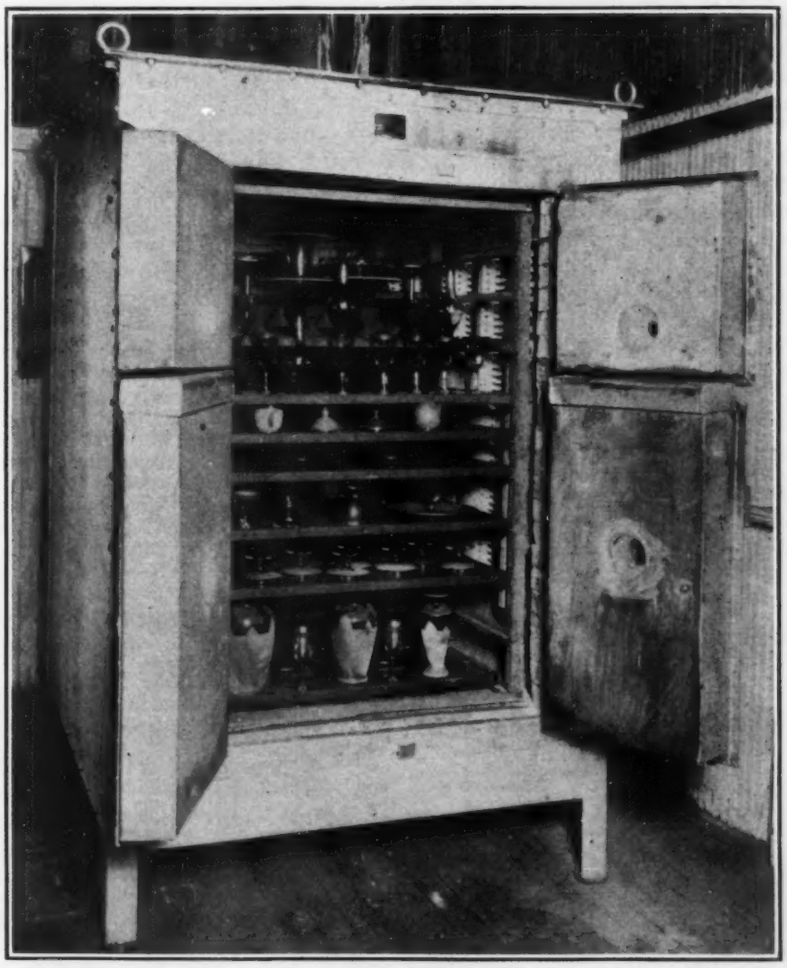
ABOUT two years ago five gas-heated kilns handled the firing of decorative glass at the plant of the Sterling Glass Company, Cincinnati. The attention of this celebrated organization was then called to the advantages of firing in electrically heated kilns, with the result that a gas-heated kiln was replaced by a 45-kw. Hayes electric oven-type kiln, the inside dimensions of which were 36x48x54 in. The load was balanced on three circuits (sides and bottom), with one circuit on each phase of a 220-volt, three-phase power line. Manual control was used on each circuit and the maximum rated operating temperature was 1,200 deg. F. The original heating elements were of nickel-chromium wire wound on asbestos board supports, but these were later replaced by round rod heating units.

Soon after putting this electric kiln into operation the Sterling company began to receive compliments from all over the country upon the improvement in the quality of its products. The response of the public to improved quality compensated for the considerably higher cost of operating the electric kiln compared with the gas kiln which it replaced. The finest ware was fired electrically and soon the demand for these pieces increased beyond the capacity of the kiln. In the spring of 1926 a second gas kiln was replaced by an electric kiln built by the Westinghouse company. This kiln has a connected load of 60 kw., operates at 220 volts with heater circuits on both sides and bottom, each being on one phase of a three-phase line. Manual control was again provided. Round rod heating elements were used and the racks, which were at first made of calorized iron, are of black iron. The inside dimensions are 36x56x60 in.

The total cost of the two furnaces installed was about $3,000.

The installation and proper operation of the second kiln resulted in a decided reduction in the firing cost per heat and per piece, and this cost now compares very favorably with gas-firing costs. The installation of a third electric kiln will reduce this cost still further, and this, with the important factor of improved quality, makes it practically certain that electric kilns will ultimately replace the gas-fired outfits. The attitude of the Sterling company is shown in the accompanying testimonial letter.

In the process of decorative glassware manufacture the firing of the colors into the glass is the most delicate and important operation. The character of the heat supplied and the control of the firing temperature are of great importance in bringing out the proper shades and the beautiful luster of the finished product. It is in these respects that the electric kiln surpasses the fuel-fired kiln.



COST OF ELECTRICITY IN KILN IS BUT 0.3 PER CENT OF VALUE OF THE PRODUCT

SUMMARY OF OPERATING DATA

Number of electric kilns	2
Total connected load, kw	105
Maximum demand, kw	60
Number of heats per nine-hour day, each kiln	2
Time of heating, hours (approximately)	1½
Time of cooling, hours (approximately)	3
Kilowatt-hours per heat, small kiln (approximately)	70
Kilowatt-hours per heat, large kiln (approximately)	90
Cost per heat using one kiln	$3 to $4
Cost per heat using two kilns	$2 to $2.50
Estimated cost of gas operation per heat for the same amount of glass fired	$1.50
Value of glassware per heat	$600 to $800
Cost of electricity for firing (in percentage of value of product)	0.3

Let us consider the operation of the two electric kilns. As shown in the accompanying illustration, between 300 and 400 pieces of glassware, in a variety of shapes and sizes, are loaded into one of the kilns at approximately room temperature. The four doors are closed tightly and all three heating circuits are usually turned on. At the end of one and one-half to two hours the material has reached the desired firing temperature, varying between 700 and 1,200 deg. F., depending upon the glass and the colors being fired, and all heat is then shut off. The electrical demand established during this operation is the connected load of the furnace and the energy consumption is full load for the heating time.

When the heat is shut off, the two top doors are opened a very little and the temperature immediately begins to drop slowly. At the end of about three hours the material is cool enough to be removed from the kiln and the glassware emerges beautifully fired and properly annealed.

While the first kiln is being heated the second one is being loaded, and when the current is turned off the first kiln the second is started, so that it is heating while the first one is cooling. By this method of operation the maximum demand does not exceed the demand of the larger furnace, the load factor is increased and the firing cost is kept at a minimum. The heating and cooling cycles are such that a third electric kiln could be staggered into the operation without increasing the maximum demand

The Sterling Glass Co.

MAKERS OF
CUT AND ENGRAVED CRYSTAL GLASSWARE
GOLD AND SILVER ENCRUSTATIONS

STERLING PLACE, NEXT HILL

CINCINNATI, O., U.S.A. Dec 17, 1926.

Mr. O. Wilhelmy,
c/o Union Gas & Electric Co.,
Cincinnati, Ohio.

Dear Mr. Wilhelmy.

Feeling that we have had sufficient time to give the Electric Kilns, which we have now been using for practically two years, a thorough trial, we take this opportunity of telling you how pleased we are with the quality of our output.

The even distribution of heat in Electric Kilns enables us to fire colors on glass in a far more satisfactory way.

With the use of Electric Kilns we have eliminated the extreme heat thrown off by Gas Kilns and with the lower degree of temperature in our Decorating Shop, our artists have benefitted, enjoying better working conditions, very pronounced during the summer months.

Thanking you, Mr. Wilhelmy, for your splendid co-operation and your selling power of convincing us that there is only one real way to fire glass and that is by ELECTRICITY.

Yours very truly,

THE STERLING GLASS COMPANY.

President.

ELECTRIC HEAT USER EXPRESSES EXTREME SATISFACTION

and still further improve the load factor, with further reduction of costs. Because of this economy of operation it is expected that a third electric kiln will be installed soon.

Formerly when five gas-fired kilns were operated on hot summer days, the heat in the firing room was almost unbearable, with the result that the efficiency of the workmen was very materially lowered. With three gas kilns now being operated the full benefit of the improved working conditions resulting from the use of electric kilns has not been derived, although the improvement is very noticeable, even with only partial electrification. It is certain that when the gas kilns are entirely abandoned the tremendous improvement resulting in the working conditions will be very decidedly reflected in the morale and efficiency of the employees. This advantage alone will be of considerable monetary value to the management.

This installation has proved that firing of decorated glassware is a splendid application for electric heat, and on the strength of its success several other installations have been made in plants doing similar work. Electric heat has done its part in building up the reputation of these products, and the introduction of electric kilns was a forward step that will never be retraced.

Wisconsin Range Revenue Averages $4.29 Monthly

AMONG 223,608 customers in Wisconsin there are 7,482 range users—a saturation of 3.3 per cent—according to data collected by Howard W. Beckwith, Southern Wisconsin Electric Company, for the Wisconsin Utilities Association. The average net price per kilowatt-hour is 3.3 cents and the average monthly bill $4.29. A separate heating rate appears to be high in favor, as does also the policy of free service for one year after installation. It is significant and perhaps indicative of the need for wider application of methods for cost allocations and determinations to different classes of business that only two out of the nine companies submitting data have records of range service costs. And these two have less than 11 per cent of the total number of customers reported or about 6 per cent of the total number of ranges.

EXAMPLES OF RANGE BUSINESS IN WISCONSIN

	Residence Customers	Range Customers	Per Cent Saturation	Water Heaters	Separate Heating Rate?	Average Net Heating Rate, Cents	Average Monthly Heating Bill, Dollars	Is Heating Load Profitable?	Recommended Type of Units	Oven Temperature Control Recommended?	Time Clock Oven Control Recommended?	Free Service	Annual Cost of Service, Dollars	1 Kw. or Larger Water Heater Recommended?	Require Double-Throw Switch?
A	11,505	227	2.1	25	Yes	3.0	5.00	Yes	Open	Yes	No	Year	7.00	....	No
B	50,000	2,000	4.0	100	Yes	3.6	4.28	Yes	Open	Yes	No	Year	No Record	Yes	No
C	885	78	8.8	6	Yes	3.6	6.50	Yes	Open	Yes	Yes	Year	No record	Yes	No
D	117,000	4,000	3.7	No record	No	3.25	4.00	Yes	Closed	Yes	No	No	No record	Yes	Yes
E	11,500	175	1.8	25	Yes	3.0	5.17	Yes	Open	Yes	Yes	Yes	3.00	No	No
F	2,005	52	2.6	5	Yes	3.0	3.75	Yes	Open	Yes	Yes	Year	No record	Yes	No
G	1,900	18	1.0	1	Yes	4.0	4.50	Yes	Open	Yes	Yes	Year	No record	Yes	No
H	21,500	42	2.0	5	Yes	3.0	4.25	Yes	Open	Yes	Yes	Year	No record	Yes	No
I	713	75	10.5	10	Yes	3.0	3.50	Yes	Open	Yes	Yes	Year	No record	Yes	No
J	6,500	815	12.5	30	Yes	3.0	5.23	Yes	Closed	Yes	No	Yes	5.00	Yes	No
Total	223,608	7,482		207											
Average			3.3			3.3	4.20								

Digest of Electrical Literature

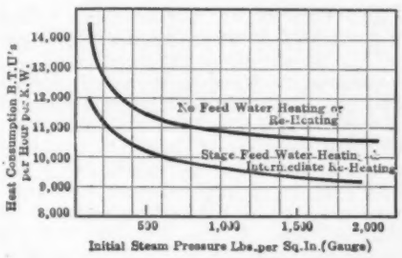
Hydro-Electric Development and Steam Equipment

Power Station Losses.—ARTHUR PAGE.—The author in this paper considers in the main the two distinct changes that take place in the process of generating electricity—namely, the transfer of heat from the coal to the water and steam, and the conversion of the heat in the steam into mechanical energy for driving the electric generators. Each of these changes is accompanied by certain losses which he groups under two headings—boiler-house losses and engine-room losses—and proceeds to discuss in detail.—*Electrical Times* (*England*), Feb. 10, 1927.

Hydro Stations on the River Lys, Italy.—T. PAUSERT.—A striking example of complete and systematic harnessing of an Alpine river is presented in this paper, describing nine electric plants situated along a 25-mile stretch of the River Lys. In this short run the level of the river descends from 8,000 ft. to 1,100 ft. above the sea. At suitable intervals dams were erected across the narrow valley, providing the nine stations with an average hydraulic head of about 750 ft. Consequently the prime movers in all plants are of the Pelton wheel type, with capacities of up to 14,000 hp. per unit. The stations supply the cities of Milan and Turin as well as local demand. To permit a tie-in with existing installations energy at 42 cycles and 50 cycles had to be provided. For this reason some of the nine stations are equipped to generate at 42 cycles, others at 50, while the two largest ones can operate their sets at either the one or the other frequency, according to demand. Transmission voltages of 45,000, 70,000 and 110,000 are installed to conform to local conditions. The paper is illustrated with 28 drawings and photographs.—*Revue Générale de l'Electricité*, Jan. 1, 1927.

Planning Problems on Water-Power Plants.—S. FÜLLSACK.—Water-power schemes, the mechanical and the electrical machinery for which are usually manufactured by different firms, sometimes need standardized treatment by independent advisers to whom problems which lie on the borderland between electrical and hydraulic engineering are familiar. In this article some questions which lead to a compromise on the planning of the mechanical portion of water-power plants are considered, so far as the major details can be adequately handled.—*A. E. G. Progress*, December, 1926.

Progress in Economy of Turbine Machinery.—CHARLES A. PARSONS, R. J. WALKER and STANLEY S. COOK.—The introduction to this article consists of a historical review of the progress in turbine design and construction. The improvements made in land turbines in recent years have largely been due, according to the authors, to increased steam pressures and superheat as well as higher vacua. Turbine efficiencies have been increased by the extensive use of end-tightened blading, thereby diminishing the leakage losses, and over-all thermal efficiencies are further increased by "Cascade" feed heating. In regard to the advantages of higher pressures, the higher the initial pressure and the lower the back pressure, the greater is the range of expansion available to the turbine, and the greater, therefore, the energy available for conversion into work. The use of mechanical gearing enables turbines in marine propulsion to be designed with a maximum of efficiency and conversion of available energy of the steam, following the lead of the land turbines. It is now being sought to realize the considerable improvement which is obtainable by further increasing the available energy per pound of steam by the use of higher steam pressures and temperatures and by regenerative heating of the feed water by previously expanded steam.—*Engineer* (*England*), Jan. 21, 1927.



ESTIMATED HEAT CONSUMPTION CURVES FOR STEAM TURBINE INSTALLATIONS WITH 750 DEG. F. INITIAL STEAM TEMPERATURE AND 29 IN. VACUUM

Transmission, Substations and Distribution

Dimensioning of Lighting Transformers.—M. VIDMAR.—Distribution transformers which serve primarily to supply lighting current are called upon to deliver daily a load which varies within a very wide range. During the night hours such transformers are practically idle, while they are frequently overloaded during the peak-load hours. The fact that the transformer permits overloading is taken for granted, and the questions arise: "What does the name-plate rating really mean?" and "How should the transformer be designed to stand a certain maximum overload safely and economically?" Very simple formulas are developed, which indicate how much a transformer of certain characteristics can be safely overloaded, or for how long it will stand a certain overload. A dry-type transformer, which is well designed for its rated output, permits only a very slight overload. A 2 per cent overload during four hours is, for example, the maximum that can be safely expected from an average dry-type transformer. An oil-cooled type, on the other hand, will permit, under similar circumstances, an overload ten times higher. The oil volume in the tank determines largely the extent of the possible overload. The author shows, however, that the oil capacity must not exceed a certain maximum, because it is expected to cool sufficiently between overload periods. A transformer with too much oil may therefore be just as uneconomical as one with too little oil.—*Elektrotechnische Zeitschrift*, Dec. 23, 1926.

Evolution of the Automatic Network Relay.—JOHN S. PARSONS.—In case of trouble on a primary feeder or in one of its transformers on a low-voltage alternating-current network it is necessary to disconnect the feeder from the system. The alternating-current network unit has been developed to connect these transformers to the network, and the "brains" of this unit, which is the automatic network relay, are described in this paper. This relay not only opens the network breaker whenever there is trouble in any of the high-tension equipment or when the power feeds back into the high-tension feeders, but also recloses the breaker when conditions are restored to normal and the feeder is in condition to supply power to the network. The difficulties which were encountered and the relay characteristics necessary to overcome them are explained briefly. Probable future development of the network relay, based upon operating experience today, is outlined by the author. Attention is called to the close relation existing between the operating characteristics of the automatic network relay and the characteristics of the system on which it is to be installed.—*Journal of A. I. E. E.*, January, 1927.

Generation, Control, Switching and Protection

Solid Contacts for Circuit Breakers.—P. CHARPENTIER.—According to former practice, satisfactory contact on air-break switches could be assured only by a multiplicity of individual contact-making elements, such as, for example, a brush with a great many thin copper leads. In late years investigators have found that properly designed solid contacts, or "block contacts," are just as reliable, are simpler and have a longer life. A relatively small contact surface, combined with heavy pressure and a massive copper block to store heat away, is the chief characteristic of a modern contacting device which has been used successfully on breakers for from 6,000 amp. to 20,000 amp. capacity, and it is described in this article.—*Revue Générale de l'Electricité*, Jan. 15, 1927.

Units, Measurements and Instruments

Discharge Delay of Spark Gaps.—L. BINDER.—High-voltage practice employs three types of spark gaps, viz., measuring gaps, protective gaps and switching gaps. The author points out that there is a great difference in the discharge delay of gaps of the first-mentioned class and the two other classes. When subjected to very short impulse voltages, a measuring spark gap will have an appreciable delay, which manifests itself in a higher flashover voltage than the spacing would require for a steady stress. Subjecting such measuring spheres to ultra-violet light, radium emanation or

X-rays will reduce the time delay of discharges to as short a period as 3.5×10^{-9} seconds; that is, to the limit of visibility. On protective gaps an increase of voltage may occur, because the resistance in the spark path does not break down quickly enough and all of the charge cannot be carried away, which will cause a piling up of potential. Illuminating such gaps with any one of the above-named rays will decrease the time delay and excess voltage, but cannot entirely avoid them. — *Elektrotechnische Zeitschrift*, Dec. 23, 1926.

Frequency Measurements with the Cathode-Ray Oscillograph.—F. J. RASMUSSEN.—The cathode-ray-oscillograph frequency-measurement circuit described in this article differs from previous circuits in the use of by-pass condensers and plate leaks which permit the connection of the oscillograph to alternating-current circuits having large direct-current components and which permit the use of biasing controls for shifting the position of patterns on the screen. The properties of Lissajous' figures are reviewed briefly and then developed more fully for the cases in which only one term of their ratios may be determined from the oscillograph pattern. Following a discussion of the accuracy of syntonization, a detailed method of calibrating oscillators is discussed. Interpolation formulas are derived for use in making interpolations on the reference oscillators. Several special circuits are described for use in frequency-measurement work with the cathode-ray oscillograph. — *Journal of A. I. E. E.*, January, 1927.

Alternating-Current Measuring Instruments.—K. IDGCUMBE and F. E. D. OCKENDEN.—This paper, as produced in its present form, is an abstract of one read before the Institution of Electrical Engineers, England, on Feb. 3. Only indicating and recording, as distinguished from integrating, meters are dealt with. A discussion of the working principles of several of the older types of meters, together with an enumeration of certain advances in design now available, is included. Moving-iron ammeters come in for a share of attention. Some consideration is given to measurements which must be made at radio frequencies. The design of instrument transformers is next discussed, and the final sections of the paper are concerned with their protection and the capacity of instruments and their accessories to withstand overloads.—*Electrician* (*England*), Feb. 11, 1927.

Temperature-Sensitive Resistors.—H. GRUSS.—For electric measurements of temperature and for compensating purposes resistances with an ohmic value which is greatly affected by temperature changes are needed. Iron or nickel wires have a temperature coefficient of about 0.5 per cent per degree centigrade whereas values at least four times as high would be desirable. As no other metals or alloys are known which would be more suitable than iron or nickel the only other way to reach the desired performance is to make the heat disposal of the wire depend upon the temperature. Surrounding the wire with a gas the heat conduction of which decreases with rising temperature will increase the heat of the wire faster than that of the ambient gas. Promising results may be expected only from gases which dissociate quickly within the desired temperature range. A satisfactory performance was obtained from iron wires sealed in a glass bulb which was filled with nitrogen-tetroxyde (N_2O_4) under a pressure of 100 mm. mercury column. As high as 10 per cent change per degree was thus obtainable although it was found impracticable to employ this value because it depended too much upon the heating current. Very stable resistors can, however, be produced with 3 per cent temperature coefficient.—*Elektrotechnik und Maschinenbau*, Jan. 2, 1927.

Heat Applications and Material Handling

Experiments on Forced-Air Cooling of Electrical Machinery.—D. H. WILLS.—This paper gives the results of experiments made on a forced-air-cooled machine to determine the relationship between watts loss, machine temperature rise and rate of flow of the cooling medium, and also the relationship between these quantities and the temperature rise of the cooling medium in passing through the machine. It is stated by the author that the method of analysis used in the theoretical consideration may be applied to any form of machine with any cooling medium.—*World Power* (*England*), February, 1927.

Electrophysics, Electrochemistry and Batteries

Electrodeposition of Metal.—W. E. HUGHES.—This article deals with the recent progress and the present situation in the electrodeposition of metals. Expansion of electro-refining and extraction during recent years is discussed at some length, and consideration is given to the factors that determine the successful commercial development of electro-refining work. Examples are given of the building up of worn and undersized parts by electrodeposition processes. An article on electroplating by the same author will follow in a succeeding issue of the journal. — *World Power* (*England*), February, 1927.

Telegraphy, Telephony, Radio and Signals

Shielded Bridge for Inductive-Impedance Measurements at Speech and Carrier Frequencies.—W. J. SHACKELTON. — A shielded alternating-current inductance bridge adapted to the measurement of inductive impedances at frequencies up to 50,000 cycles is described. The bridge comprises a balancing unit and associated standards of inductance and resistance. The balancing unit has resistance-ratio arms specially constructed to meet the requirements imposed by the above frequency range named. The reference standard makes use of inductance coils of a new type, their cores being of magnetic instead of non-magnetic material as is usually the case. The use of such cores results in coils that are smaller and hence better adapted to assembly in a multiple-shielded standard. Equations expressing the errors resulting from any small residual capacitance unbalances in the resultant bridge work are given, and calculations are made of the balances required for the desired degree of measurement precision. Test data are presented illustrating a method of experimentally checking the residual shunt and series balances, from which it is concluded that the bridge is capable of comparing two equal inductive impedances of large phase angle with an accuracy, at the maximum frequency, of 0.02 per cent for inductance and 1.0 per cent for resistance. — *Bell System Technical Journal*, January, 1927.

Phenomenon of Direct-Current Self-Excitation in Vacuum Tubes. — N. MINORSKY.—Numerous attempts are being made to apply the remarkable properties of the three-electrode vacuum tube to uses other than radio. Theoretically, the applications of vacuum tubes in this connection, according to the author, are very attractive; in fact, the tube constitutes a very sensitive relay without any inertia and with very high ohmic resistance, which makes it especially well adapted to operate in series with highly inductive circuits, since the time constant of the circuit is reduced and the control is much more rapid. However, the difficulties inherent to the existing schemes of direct-current amplification handicap further progress in this direction considerably. The author reviews briefly the new scheme as a straight direct-current amplifier, then as a regenerative direct-current amplifier. He discusses characteristics of receiver circuits and provides experimental checks of the conditions of stability in vacuum-tube circuits. A comparison is given between the vacuum-tube contact effect system and existing apparatus. He diagrams a vacuum-tube system which represents a special kind of electrostatically controlled relay with an enormous power amplification that can be utilized for many practical purposes, a number of which he enumerates. The applications of this new "electronic contactor" should appeal, according to the author, both to the common sense of the industrial engineer and to the creative imagination of the inventor by the possibility of making ergs control kilowatts in a simple and reliable manner.—*Journal of Franklin Institute*, February, 1927.

Miscellaneous

Complex Numbers in Engineering.—G. WINDRED.—The object of the author is briefly to set out in a form designed to be useful for application to electrical engineering calculation the theory of the method of mathematical representation which makes use of the symbol J, which is numerically equal to $\sqrt{-1}$ and is consequently a purely imaginary term. The discussion, the author says, is by no means complete, the paper being simply an attempt to bridge the gap which appears to exist between the theory of the complex quantities as described in mathematical textbooks and as employed, usually without thorough explanation, in a few electrical engineering textbooks and in certain electrical papers.—*Electrician*, (*England*), Feb. 11, 1927.

News of the Industry

Power Investigation Sought

Senator Walsh of Montana Asks Special Committee to Delve Into Production of Electricity and Gas

AN INVESTIGATION into the growth and capitalization of public utility corporations supplying electric light and power or gas, and of corporations holding stock in such corporations, was provided for in a resolution introduced into the Upper House of Congress on Feb. 25 by Senator Walsh of Montana.

The resolution provided that the inquiry be made by a committee of five Senators and include in its scope the method of issuing and the price realized or value received for the various security issues of both classes of corporations named, including bonds and stock; the extent to which additions or extensions to the property of the operating companies have been made, and the value or detriment to the public of holding companies owning the stock or otherwise controlling such operating companies immediately or remotely, with the extent of such ownership or control. The committee was instructed to recommend legislation, if any, which in its opinion should be enacted to correct any abuses that may exist in the organization or operation of such companies. Full powers of inquiry were given the committee by the terms of the resolution, which was sent to a committee and was still buried there as the ELECTRICAL WORLD went to press on Thursday.

In speaking to his motion, Senator Walsh quoted from the ELECTRICAL WORLD and other sources to show the great extent and rapid growth of mergers under holding-company control, referred to Professor Ripley's arguments on that subject, asserted that while "rates are advanced with relative ease they come down more leisurely," and, in alluding to the argument that the public service commissions prevent abuses in capitalization and excessive rates, said: "In this connection the revelations of the Reed committee of the contributions of mammoth sums by officials of public utility corporations for campaign purposes assume a most seriously sinister significance."

Program Arranged for I.E.C. Meetings in Italy

C. Le Maistre of London, general secretary of the International Electrotechnical Commission, announces that the opening date of the advisory committee meetings to be held in Italy next fall has been advanced slightly and that the delegates will assemble at Bellagio on Monday, Sept. 5, where on that day and on Sept. 6 and 7 meetings of the committees will be held. On Sept. 8 commemorative ceremonies in observance of the hundredth anniversary of Volta's death will be held at Como in connection with the meeting of the Scientific International Council. The advisory committees will resume their sessions on Sept. 9 and 10; on Sept. 11 there will be an excursion to important hydro-electric plants, and on Sept. 12 the committee meetings will close.

On Tuesday, Sept. 13, delegates will leave by special train for Milan, where they will be guests of the Milan Section of the Associazione Elettrotechnica Italiana; on Sept. 14 they will be at Venice, on Sept. 15 will visit plants at Santa Croce, and from there will go to Florence and Rome. At the latter city the plenary meeting of the I.E.C. will be held on Sept. 21. The tour has been arranged by the Italian national committee of the commission.

Senators Turn Down Boulder Dam

Efforts to Force Vote on Swing-Johnson Bill Fail—Compromise Measure Thought Likely to Come Before New Congress—Reaction to Walsh Resolution

BY PAUL WOOTON
Washington Correspondent ELECTRICAL WORLD

WHEN the motion of Senator Johnson of California to impose closure on debate in the case of the Swing-Johnson Boulder Canyon Dam bill and thus force it to a vote came up in the Senate last Saturday, it was rejected by 59 to 32, only one-third instead of the required two-thirds of Senators voting being recorded for it. On Monday the bill was displaced as unfinished business and the last chance of its passage by this Congress vanished. It went into the discard, as did Muscle Shoals, despite a last-minute resolution by Representative Almon of Alabama to create a joint commission of five Senators and five Representatives to study the last-named undertaking once more.

To disinterested observers of Congress it is very apparent that the Boulder Dam bill in its present form will have no more chance to pass at the next session than it had at this session. For that reason it is believed that California will be willing to make concessions which it was unwilling to consider before the failure of the desperate effort to put this legislation through. Negotiations already are on foot looking to informal conferences among representatives from the various states and of the private interests concerned. None will be surprised to see some practical compromise worked out in the interim before the new Congress assembles. There also is the possibility that an expert committee drawn from the executive departments concerned may be set up to make a recommendation in connection with the development of the Colorado River.

Senator Walsh's Resolution

To talk abstractly in the Senate about economic possibilities frequently makes an impression upon members of that body, but when Senator Walsh undertakes to discuss corporate organization in the Upper House he enters a field with which most members of the Senate are familiar. The Senate is composed mainly of lawyers. In the course of their practice they have become familiar with the practical reasons which have given rise to our rather complicated corporate structure. Even those members who are not lawyers, for the most part, have had personal experience in the handling of corporate matters.

Owing to the fact that most of the members of the Senate realize from first-hand knowledge that business organization usually follows lines dictated by practical and utilitarian reasons, Senator Walsh's speech attacking public utility organization, made in moving the resolution for investigation reported in an adjacent column, did not impress the Senators as might have been the case otherwise. They also know that the whole tendency in business is toward simplification. Just as a mechanical device progresses from complicacy to simplicity, so will be the course of development in corporation organization. Many of the members know that subsidiary corporations and holding companies are not formed primarily to facilitate stock jobbing.

It also is contended on Capitol Hill that despite the concern which Senator Walsh expressed for the small stockholder in utility enterprises, he himself is doing more to injure that class of stockholder than any one else. Moreover, it is declared, the tactics which he is proposing tend to scare out the small stockholder. The large stockholder is not going to be frightened by any threat of an investigation. Apprehension is felt that the highly desirable form of public ownership through diversified holdings of stock will be discouraged and the ownership become more concentrated in a few individuals.

It also is pointed out that Senator Walsh failed to mention that the states have the right to require that any public utility be owned by their citizens. Since the individual states are in a position to protect themselves against

abuses from holding companies, there is failure to grasp just why the federal government should concern itself in this matter. It also is not clearly understood why an academic discussion of this subject should be launched just at a time when the Federal Trade Commission has given the electrical industry a clean bill of health, after more than a year spent in an exhaustive study of that situation.

Reed Committee Asks Citation of Insull for Contempt

Samuel Insull having repeated his refusal to divulge to the United States Senate campaign investigating committee the names of candidates for political county offices in Illinois to whose primary campaigns he admits contributing $40,000, he was, with his attorney and a recalcitrant witness in the Pennsylvania inquiry, to have been cited to the Senate on Monday as in contempt of that body. Filibustering proceedings started by Senator Reed of Pennsylvania with the object of defeating a resolution to extend the life of the campaign investigating committee, headed by Senator Reed of Missouri, prevented, however, the citation requested by that committee, and when the ELECTRICAL WORLD went to press on Thursday the outcome of the struggle was in doubt. The life of the Congress was constitutionally ended on Friday.

Crowd Hearings at Augusta

Maine Citizens Aroused Over Question of Exportation—Power Companies Champion Smith Bill

EXTRAORDINARY public interest was shown last week in the water-power bills before the Maine Legislature, when joint committee hearings were held at Augusta in the presence of audiences that filled the galleries of the House of Representatives and overflowed into the corridors of the Capitol. Six bills were considered in joint session. Public utility interest centered in the attempts of Senator Carter of Androscoggin to strengthen the Fernald non-exportation law by making it applicable to the charters of all electric power companies; in the Smith bill, sponsored by the Central Maine Power Company, which, as previously explained, provides for the creation of transmission companies to export surplus power under the regulation of the Public Utilities Commission, and in the bill of Senator Oakes of Cumberland providing for a commission investigation of the possibilities of a compact between Maine, New Hampshire and Vermont for power exportation under federal sanction.

The legislative temper appears to favor modification of the Fernald law, but political attacks have aroused the less-informed portion of the public to an attitude unfavorable to changing it. The weight of this mass of undigested opinion upon the Legislature has not yet been measured. On the other hand, the open publicity of the power-company interests in favor of exporting surplus power is having its effect. President Walter S. Wyman of that company, at the hearing on Friday, offered an amendment to the Smith bill under the terms of which each company would be required to agree to expend one-half its export power revenue upon rural service development for the next ten years, the amount so disbursed not to exceed $250,000 per year for any one company. This proposal did much to disarm agrarian hostility to exportation.

Engineering and economic aspects of surplus power exportation were discussed by Mr. Wyman at the hearing on Friday, when he asserted that within the next ten years $50,000,000 worth of new hydro-electric construction will be carried out on the upper Kennebec River if exportation of surplus power is allowed. Rural extensions will be pushed more rapidly, and the state will benefit through increased revenue from taxation, lower cost of service and the entrance of large industrial enterprises which will use low-priced power developed on a wholesale basis not possible under the present restrictions.

Another feature of Friday's hearing was an able exposition of the Smith bill by Edward F. Merrill of Skowhegan, counsel for the Central Maine company. W. B. Skelton of Lewiston, a former member of the Maine Public Utilities Commission, also spoke in favor of the bill. The power interests oppose the Oakes bill on account of its involvement with federal control, uncertainties of compact agreements between states and further delays.

Another Big Hydro Plant for South

Twenty-Million-Dollar Project for Saluda River on Site 10 Miles from Columbia, S. C., Announced by W. S. Barstow Interests—Murray & Flood the Engineers

DETAILS of a coming large hydro-electric undertaking on the Saluda River in South Carolina, whose possibilities were seen and are sponsored by W. S. Murray of Murray & Flood, consulting engineers, New York, and which has been under study for about two years, have just been announced by the General Gas & Electric Corporation, of which W. S. Barstow is president. This company has already important interests in South Carolina, owning the Broad River Power Company, with headquarters at Columbia, and the South Carolina Gas & Electric Company at Spartanburg.

The site selected is 10 miles west of Columbia; the initial expenditure is put by the General Gas & Electric at $20,000,000; the eventual installation will be 200,000 hp., the annual output will, it is predicted, be 300,000,000 kw.-hr., and the dam, the promoters say, will be the largest in the country. The project, it is declared, will, under comparable conditions of rainfall during drought, yield a greater amount of 24-hour power than is at present possible at Muscle Shoals. Work will start immediately, and the greater part of South Carolina will eventually be served. To control the development the Lexington Water Power Company has been organized. This company obtained a preliminary permit from the Federal Power Commission last summer for a smaller project. Most of the power generated will be sold to the Broad River Power Company. Some further particulars given out by the General Gas & Electric follow:

1. The proposed dam is to be more than 8,000 ft. long, 188 ft. high, and will contain 11,000,000 cu.yd. The material will be brought in and placed in the dry by railroads and an impervious core will be made by hydraulically washing the fine materials into the central third portion of the dam.

2. The storage of water behind the dam will be the largest of any in the United States, and the lake created will be more than 30 miles long and at one point 14 miles wide, with an average width for the entire length of nearly 3 miles.

3. The huge quantity of water to be stored in the upper 60 ft. of the basin will permit it to carry in suspension a very large amount of potential energy. In the event of a drought lasting for 25 consecutive weeks there would be available 500 hp. to each of 40 mills for six working days of ten hours each a week. Simultaneously, additional energy would accrue from water flowing into the lake during such a period, and this would more than offset losses incident to the transmission of power from the generating station to the mills.

Murray & Flood will be the supervising engineers.

Pinchot and Murray Hold Debate on Power

Former Governor Pinchot of Pennsylvania and W. S. Murray, consulting engineer, New York, debated the merits of "giant power" before the Portland (Me.) Economic Club on Feb. 17, the large audience, including officials, leading business and professional men and prominent public utility executives and engineers of the Pine Tree State. Mr. Pinchot, who was fresh from an address made to the Maine Legislature at Augusta on the same subject, made a violent attack upon the development of interconnection and consolidation of properties in the electrical industry and assailed commission regulation, declaring that the members of the Pennsylvania commission "were owned body and soul by the power companies" and picturing the virtual enslavement of the American public through the progress of superpower.

In his reply Mr. Murray, who was chairman of the commission that under government auspices investigated the opportunities for an interconnected power system in the Northeastern States, dwelt on the economic fallacies pertaining to the construction and operating plans proposed by the Giant Power Survey. He stressed the

point that their adoption would inevitably lead to the political confiscation of the highly efficient electric utility properties in Pennsylvania, now valued at over $750,000,000, since it was proposed to place that management under the control of a so-called "Giant Power Board," the members of which were to be the appointees of the Governor, and, with the exception of a single engineer, were to be men already charged with other duties of the state and whose training would be entirely foreign to the highly technical art of producing, transmitting and distributing power. Mr. Murray thought that under such a régime the inevitable collapse of the power industry in Pennsylvania must lead to loss of property, increase in the state debt and consequent increase in taxation.

The meeting closed with an address by Major Glenn E. Edgerton, chief engineer for the Federal Power Commission, upon the work of that body.

Iowa Men Meet at Dubuque

State Section of N.E.L.A. Takes Up Commercial and Distribution Problems—Farm Service

SUCCESS of a new convention plan, figures to show that Iowa leads all other states in the degree to which it can be and has been electrified, re-election of all officers so that the projects now in hand may be carried to conclusion under their direction, and selection of Cedar Rapids as the 1928 convention city, marked the two-day session of the Iowa Section of the National Electric Light Association held at the Julien Dubuque Hotel, Dubuque, on Feb. 24 and 25. Three hundred delegates were in attendance, which was a record.

Unusual success from the standpoints of good attendance and lively discussions is attributed to a new policy adopted for this convention, which was turned over to commercial and distribution men. In turning the convention over to them, the executive committee aimed at achieving greater practical benefit to the industry than in past conventions. Next year, at Cedar Rapids, there will be three parallel sessions—one for distribution representatives, one for commercial representatives and one for plant operators.

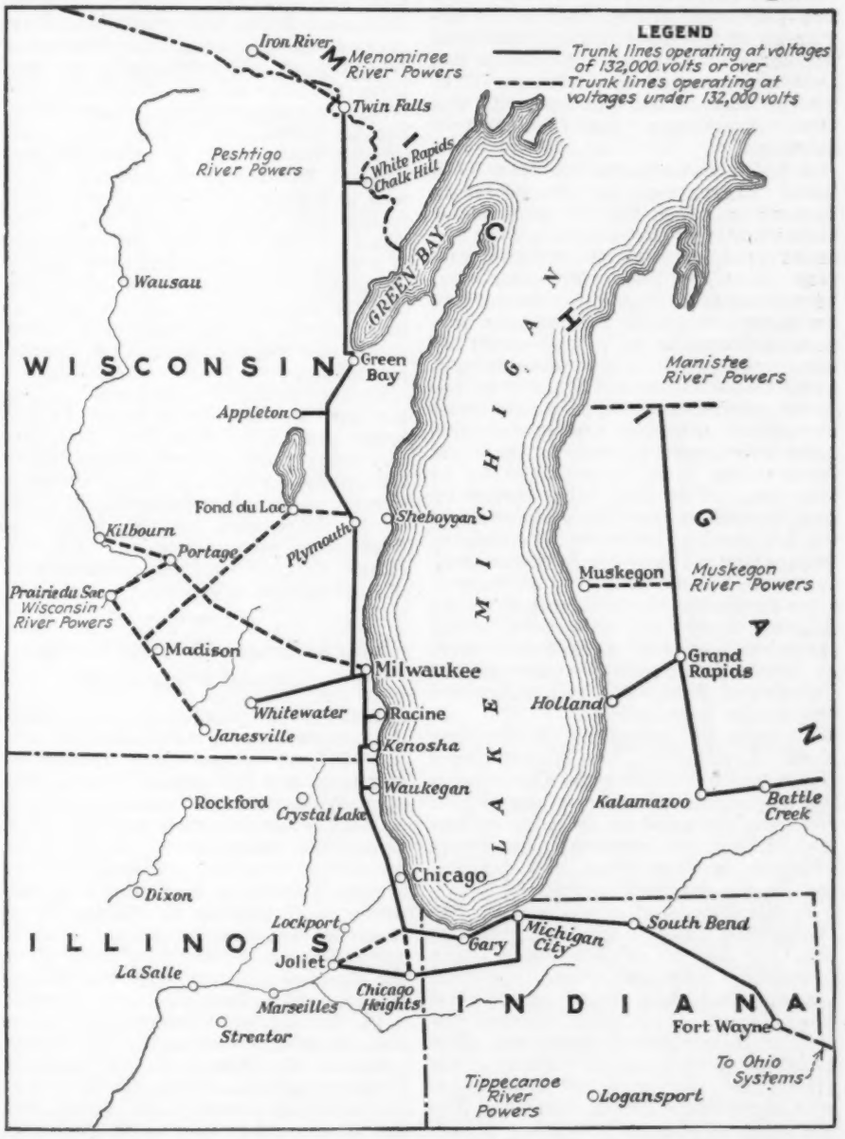
At the sessions devoted to sales activities papers and talks were given on sales problems of electrical refrigeration, ranges and cooking, and home, business and street lighting. The distribution meetings covered the subjects of transformer loadings, safety, unaccounted-for energy and line drops in voltage. The joint meetings were devoted to the co-operation of commercial and distribution departments in building revenue and good public relations and to the importance of the sale of proper equipment in adding load and improving load factor. A striking collection of data on the uses of energy in farm service was presented by Prof. Frank D. Paine, supervisor of Iowa's rural project at Garner.

Among those on the program for papers and talks at the commercial sessions were: Refrigeration, J. F. Roche, C. H. Dickey and D. B. Holland; ranges and cooking, P. L. Miles; better lighting, L. V. James and L. Friedman; sales activity, W. L. Berry, chairman Commercial Section, Middle West Division, N.E.L.A. At the distribution sessions A. C. Farmer and Charles Clark talked on transformer loading, K. R. McKinnon on safety, W. S. Wick on resuscitation methods, M. A. Harpster on unaccounted-for energy, and R. O. Sutherland and R. F. Ingham on voltage loss.

Charles Clark, Des Moines Electric Light Company, opened the joint meeting on Friday, at which E. G. Nichols, K. A. Hills, E. S. Schreiner, A. R. Battern, C. E. Murphy and George Charlesworth were the scheduled participants.

The re-elected officers are: President, Clarence S. Macy, Des Moines Electric Light Company, Adel; first vice-president, George A. Neal, Iowa Light, Heat & Power Company, Fort Dodge; second vice-president, H. C. Orton, Interstate Power Company, Dubuque; secretary and treasurer, H. E. Weeks, United Light & Power Company, Davenport.

Interconnected Lines Soon to Encircle Lake Michigan



WHEN the 132-kv. transmission line from the Milwaukee Electric Railway & Light Company's Lakeside plant at Milwaukee, already reaching Kenosha, Wis., is extended south to meet at the Illinois state line a similar line built by the Public Service Company of Northern Illinois north from Waukegan, Ill., in accordance with the agreement between these companies noticed in the ELECTRICAL WORLD for Nov. 27, 1926 (page 1138), there will be a continuous stretch of lines at high voltage, built or building, from Twin Falls, Wis., near the Michigan border, as far east as Boston and another of the few gaps that now exist in the eventual network to stretch from the Canadian border to the Gulf will be bridged. This, of course, involves no actual transmission of power beyond the well-defined economic limits.

If a talked-of line to reach from Kalamazoo, Mich., to South Bend, Ind., should eventually be built, Lake Michigan would be virtually encircled with high-voltage lines stretching from the Manistee River water-power sites on the east of the lake around through Indiana and Illinois and north through Wisconsin to the Menominee River sites on the northwest.

In the Legislative Mill

Ohio's "Hold-Over" Commission Is Being Reconstituted—Bill to Amend River Regulation in New York

OHIO'S long fight over the personnel of the Public Utilities Commission is approaching a close. Two of Governor Donahey's appointees, James W. Huffman of Chandlersville and Judge William Klinger of Lima, Democrats, have been confirmed by the Republican Senate. They both succeeded men "holding over" long after the expiration of their terms. Frank B. Maullar, whose term expired on Feb. 1 this year, was still in office at the beginning of this week, as no Republican appointee of Governor Donahey's had then been accepted by the Senate. C. C. Thorpe was named and rejected. The Ohio commission has only three members.

A bill introduced into the New York State Legislature by Assemblyman Sargent to amend the law establishing river-regulating districts lays down the broad principle that the primary purpose must be flood prevention and preservation of the public health and wellbeing. Wherever the primary purpose is found to be private profit by means of water-power development, even where incidental benefits to the public accrue, such applications must be denied. Another amendment provides for proper returns to the state from power projects growing out of river regulation. This bill is backed by the Association for the Protection of the Adirondacks and owes its origin to the application last year by the Malone Light & Power Company to have a river-regulating district created on the Salmon River—an application which led to bitter opposition and controversy, as reported in various issues of the ELECTRICAL WORLD last fall, and which was finally withdrawn.

Under a bill introduced in the New York Legislature by Assemblyman Boyle, the Public Service Commission law is amended by adding a new section requiring electrical corporations to furnish at their own expense to all owners adjacent to their lines and desiring service the necessary poles and wires.

A bill introduced at Albany by Assemblyman Emerson gives authority to the City Council of Watertown by a four-fifths vote to utilize electrical energy generated at the municipal plant for street lighting and sell the surplus to residential consumers, office buildings and industrial plants, thus placing the city in direct competition with the private power interests. The bill failed of passage last year.

Favorable report on the bill to repeal a section of the charter of the Susquehanna Power Company prohibiting transmission or sales in Baltimore of any electricity generated by the company has been made to the Maryland Senate by the committee on judicial proceedings and adopted unanimously. A similar bill is before the House.

Every kilowatt-hour of electrical energy generated or used in North Carolina would be taxed under a bill introduced by Representative Winston. The proposed measure imposes a tax of one mill per kilowatt-hour "upon all such energy metered to the transmission lines at the point of such production," with a reduction of one-quarter mill on energy used for manufacturing and a reduction of one-half mill on energy sold in rural communities. The bill has been referred to committee, but it is considered to be destined for sure defeat.

The Nebraska House has indefinitely postponed a bill which would have forbidden public utilities to sell any merchandise at retail. It was aimed particularly at the sale by electric light companies of electrical appliances.

The Indiana House of Representatives has advanced to third reading the McKesson-Drake bill, which would authorize municipalities, on vote of a majority of the electorate, to buy, lease and operate public utilities free from the control of the Indiana Public Service Commission and to issue bonds against the property to effect the purchase. Extensive amendments have been proposed to the Moorehead public utility bill, which is still before the Senate. These include the extension of commission jurisdiction over holding companies, the exhaustion of opportunities for appeal in the state courts before recourse is had to federal courts, and a new method of appointing commissioners.

Public utility corporations selling gas and electric power would be put under a state indeterminate franchise and many matters of regulation left to the Minnesota Railroad and Warehouse Commission, under the terms of a bill to be introduced in the Minnesota Legislature now in session. The bill leaves the rate-making powers with city officials as at present.

New Officers Elected for the Edison Pioneers

William H. Meadowcroft has been elected president of the Edison Pioneers for 1927, in succession to George F. Morrison, and William H. Atkins, Fremont Wilson, James Lyman and Philip G. Gossler have been elected vice-presidents. Mr. Meadowcroft retains also his former function as historian of the society, and Frank A. Wardlaw as secretary and Charles E. Estabrook as treasurer continue in office. John W. Lieb, William S. Barstow and Edwin W. Hammer make up, with the officers, the executive committee.

In the list of Pioneers printed on Feb. 19 as in attendance at the dinner given to Mr. Edison on his eightieth birthday the name of Joseph Insull was inadvertently admitted. Mr. Insull, who for 25 years has been associated with the General Electric Company at Pittsfield, Mass., became connected with the Edison interests in 1887.

President Coolidge Appoints Radio Commissioners

Nominations for the commission of five provided for in the new law to regulate radio transmission have been sent by President Coolidge to the Senate for confirmation. The nominees are, in addition to O. H. Caldwell, whose selection is noted under "Men of the Industry" (page 523), Rear Admiral W. H. G. Bullard of Pennsylvania, former Judge Eugene O. Sykes of Mississippi, Henry A. Bellows of Minnesota and John F. Dillon of California. With the exception of Judge Sykes, all the nominees have expert acquaintance with the radio art.

Opposition to the confirmation of Messrs. Caldwell, Bellows and Dillon was manifested in the Senate on the alleged ground of their being selections of Secretary of Commerce Hoover, to whose authority in radio matters some Senators are opposed, and on Thursday it seemed doubtful whether the nominees would be confirmed in the jam of business attending the end of the session. In case of their non-confirmation it is understood that the President will extend recess appointments to them.

Notes from the Dominion

Parliamentary Fight Over Carillon Site Begins—New Unit Goes in at Chelsea Site on Gatineau

OPENING guns in the political fight in Canada over the Carillon power rights on the Ottawa River were fired in Parliament on Feb. 25 during the debate on the budget. H. H. Stevens of Vancouver accused the Liberal government of being prepared two years ago to give a contract to United States interests which would have enabled them to transport the power across the border. Premier Ferguson of Ontario and Premier Taschereau of Quebec, he said, had prevented the federal government from going ahead. Charles Stewart, Minister of the Interior, denied the statements of Mr. Stevens with great emphasis and was sustained by J. A. Robb, Minister of Finance. The debate, which waxed warm and caused an uproar in the House, will be resumed.

It is said that the International Paper Company may make a bid for Carillon. There is also a rumor that another influential Montreal group has a similar ambition. Up to the present, however, the two principal groups openly conducting a fight for the site are the Montreal, Ottawa & Georgian Bay Canal Company and the National Hydro-Electric Company. The bill for the renewal of the charter of the former has gone over.

Another step toward the completion of the Gatineau Power Company's great hydro-electric development in the Gatineau district of Quebec was reached recently when the second 34,000-hp. generating unit at the Chelsea plant was operated for the first time. This makes a total of 68,000 hp. available to date at Chelsea for use in the International Paper Company's newsprint mill at West Templeton.

Announcement has been made that the Mistassini Power Company, which is carrying out a big pulp and paper enterprise in the Lake St. John district of Quebec, will spend in the neighborhood of $8,250,000 between now and next November. At present the company is buying its electric power from the Duke-Price Company, but next year it will harness two series of rapids which flow along its property and build its own plant.

Order No. 27 Rescinded

Pennsylvania Commission Asserts that Ordinance Adopted Last Year Proved Unworkable

GENERAL Order No. 27 of the Pennsylvania Public Service Commission, a widely advertised and somewhat famous ordinance pertaining to rural service, the chief provisions of which were printed in the ELECTRICAL WORLD for Jan. 30, 1926 (page 266), has been declared unworkable by the commission, which says that persistent effort to enforce it has been followed by unsatisfactory results. It will therefore be superseded by General Order No. 28, recently adopted by the commission and framed along quite different lines.

The old order, which will be nominally in force until April 1, thirteen months after it became effective, stipulates that a company must extend its lines when there is at least one contracting consumer per measured mile of line, the company paying the entire cost of each measured mile where there are three or more contracting consumers and $300 per contracting consumer when there are less than three in the measured mile, a measured mile being defined as either an actual mile or any fraction thereof, according to circumstances. Chief provisions of the new order are as follows:

It shall be the duty of every electric company to make line extensions within the territory in which it is chartered to operate, provided that applicants on such extensions shall, after establishment of credit, contract for the payment for energy supplied them at the electric company's filed rates for supply of energy from line extensions, and thus become consumers as defined herein.

On or before March 1, 1927, every electric company shall have filed with the commission as part of its tariffs, to be effective April 1, 1927, a rule stating the conditions under which it will make line extensions to supply any consumers within its chartered territory applying for service in accordance with the terms of this order. Included therein shall be a plan by which it will construct and thereafter operate and maintain at its own cost line extensions required to serve any consumer or consumers who will guarantee revenues therefrom in sufficient amount to comply with the requirements set forth in said rule, and a statement of the terms upon which the guarantee shall be reduced to minimum charges as provided in schedules applicable to each class of service to be supplied, such as residences, farms, stores, hotels, garages, industrial establishments, etc.

In determining the revenues originally so to be guaranteed and any subsequent changes therein: (a) The total construction cost of the line extension shall be credited with all money, labor, materials or other items of cost contributed by said consumers, at the cost to the electric utility of all of the items entering into said contribution, and total revenue to be guaranteed shall be based upon such cost after credit as aforesaid; (b) appropriate adjustments shall be made at least annually in the amount of revenue guaranteed by each consumer on account of change in the number and (or) classification of consumers supplied from the line extension. Each company shall have available a mixed power and lighting schedule under which farm service will be furnished through one meter.

After prescribing standards for construction, operation and maintenance of line extensions and for the consumers' wiring and equipment, the order continues:

No electric company shall be obligated by this order to deliver current to any line extension financed in part by consumers until every consumer participating in said financing shall have agreed in writing that the ownership of such line extension shall vest in such electric company. Such electric company shall be obligated to maintain and replace at its own expense all line extensions constructed under this order as public safety and convenience may require.

Additional consumers will be connected to a line extension already built or to a further extension thereof only upon the same terms and conditions as would apply were the extension then being made for all consumers, including the new consumers, provided the inclusion of such new consumers will not increase the cost to the existing consumers. Otherwise, any line extension constructed to serve such additional consumers shall be considered and treated as a new and separate line extension.

In order to determine the length of time in years for which consumers on a line extension shall contract for service, the estimated cost of construction of a line extension shall be divided by the estimated annual revenue therefrom. Such term shall not be less than one year nor more than three years. This section shall not apply to incidental temporary service.

Cooper Retained for Hydro Project on Dnieper

Alexis V. Prigarin, chairman of the board of the Amtorg Trading Corporation, announced this week that he had completed the final negotiations with Colonel Hugh L. Cooper, builder of the Wilson Dam at Muscle Shoals, whereby Colonel Cooper is retained by the soviet government as chief consulting engineer of the superpower project on the Dnieper River, in the Ukrainian Soviet Republic.

"The Dnieper plant will be the largest hydro-electric development in Europe," said Mr. Prigarin, "and a most important link in the chain of superpower plants now being developed in the Soviet Union. With its ultimate capacity of 470,000 kw., it will be by far the largest, although several plants of from 50,000 kw. to 100,000 kw. capacity are now in process of construction. Today the capacity of the larger stations in general public service in the Soviet Union is already three times the total of 1917, and construction which will increase the total capacity by 300,000 kw. is in progress. The Volkhov hydro-electric plant, near Leningrad, will operate at its full capacity of 56,000 kw. within a few weeks. During the present year the soviet government will spend upward of $50,000,000 on the larger stations for new construction and additions, exclusive of the Dnieper project."

Colonel Cooper confirmed the report of his appointment, saying:

"The works will be built and financed by the soviet government and will cost approximately $70,000,000 and require about six years for their construction, 650,000 hp. being eventually installed in a modern hydro-electric plant. A flight of three locks lifting craft by the 120-ft.-high dam will make the Dnieper River navigable from the Black Sea for a distance of about 600 miles through the Ukraine coal, iron and wheat belt. The completion of this project will give Russia a vast unit of hydro-electric energy at a cost well below the average cost of hydro-electric energy in the United States and at the same time produce low costs of transportation for imports and exports through Kherson and east of Odessa."

The soviet government has appropriated $6,000,000 for this year's work, the Ukrainian government $3,000,000, and more is to be raised among local interests.

Sleet Storm Damages Lines in Northern New England

Telephone and telegraph lines in northern New England sustained damages estimated at half a million dollars last Saturday in a heavy sleet storm which felled about 2,400 poles and also did considerable injury to electric power transmission and distribution circuits. The trouble was greatest in southern Maine and New Hampshire.

The Cumberland County Power & Light Company of Portland, which was hit harder than any other central station in the storm area, wired the ELECTRICAL WORLD on Monday that the storm was of a localized and cyclonic nature with a nine-inch fall of very heavy damp snow which stuck to everything and then froze, giving the small wires the appearance of enormous cables. A 50-mile wind broke down these loaded wires by the hundreds. Of ten main transmission lines from hydro-electric plants two remained in service. Interconnections with other companies were also out of commission for a time, so that the company's steam plant in Portland saved the day. Virtually normal service was restored by Monday night, but weeks will be required for reconstruction. The company's loss is roughly estimated at $150,000.

The Central Maine Power Company wires that it came through the storm remarkably well, with local trouble only in three seacoast towns, which was ended by Sunday noon. Radio messages were received from the Portland company asking for power, and the Central Maine was able to respond. The Portland company also used radio from Portland for instructing the operating shifts at its hydro stations during the interruption of telephone communication. The Bangor Hydro-Electric Company wires that the storm caused no damage or interruptions on its system.

Tri-State Delaware River Treaty Up Again

A tri-state treaty providing for regulation of the use of the water flow of the Delaware River above Trenton, N. J., by allocating 600,000,000 gal. a day to New York and New Jersey and 900,000,000 gal. to Pennsylvania is again before the Legislatures of the three states affected. A similar treaty last year was defeated by the refusal of New Jersey to concur, and strong opposition is once more manifest in that state. The city of Trenton is particularly perturbed and has engaged Major Ezra B. Whitman of Baltimore, a consulting engineer, to study the treaty and survey conditions along the Delaware Valley. Trenton's fight is based on the fear that if the pact is adopted by the three Legislatures the flow of the Delaware River will be greatly lessened.

Although the need of the water for other purposes is likely to preclude any considerable power development under the terms of the treaty, the Philadelphia Chamber of Commerce favors the erection of a dam in the river at Milford, Pa., to increase Philadelphia's water supply and permit the generation of power. Such a dam is prohibited by an existing treaty between Pennsyl-

vania and New Jersey. The proposed dam site is at Wallpack Bend, at the mouth of Bushkill Creek. Exponents of the plan say it would cost less than would be required to develop tributaries of the Delaware and Lehigh Rivers, as has been proposed. Cost of the Milford project is roughly estimated at $10,000,000.

Purchases and Mergers

Western New York Utilities Company Passes to the Buffalo, Niagara & Eastern—Other Transfers

AUTHORITY has been given by the Public Service Commission of New York to the Buffalo, Niagara & Eastern Power Corporation of Buffalo to acquire all or more than 10 per cent of the outstanding common stock of the Western New York Utilities Company, Inc., Batavia, upon the expressed condition that in granting the order the commission does not pass upon the value of the property of the Western New York Utilities, nor upon the reasonableness of the price to be paid. The Western New York Utilities supplies electricity in Batavia, Albion and Medina and various other municipalities in Erie, Genesee, Monroe, Niagara, Orleans and Wyoming Counties, territory contiguous to that served by the Niagara, Lockport & Ontario Power Company, more than 95 per cent of the common stock of which is now owned by the Buffalo, Niagara & Eastern Power Corporation. The stock of the Western New York Utilities to be acquired consists of 27,500 shares, without par value, and the price to be paid is $200 a share.

The municipal electric and water plant at Ridgely, Tenn., and the electric property at Tiptonville, Tenn., have been sold to the Union Electric & Gas Company. These properties will be owned by the Southern Utilities Company, a subsidiary of the Union Electric & Gas, under the management of Gannett, Seelye & Fleming, Inc., of New York, Harrisburg and New Orleans.

Merger of three Fitkin Florida companies—the Pinellas County Power Company, the Florida Power Corporation and the Central Florida Power & Light Company — into the Florida Power Corporation is announced by the National Public Service Corporation.

The Interstate Power Company of Nebraska has been organized to take over the properties in that state of the Interstate Power Company, the Tri-States Utilities Company and the Minnesota Electric Distribution Company, the two latter having been purchased within a year by the first named from the W. B. Foshay interests of Minneapolis. The properties are in ten northern and northeastern counties and have a book value of $3,280,000.

The Central States Electric Company, with headquarters at Omaha, has authority from the Nebraska commission to purchase the generating stations and distributing systems in the villages of Homer and Winnebago and the generating plant at Walthill, three adjoining towns in northeastern Nebraska.

Oto, Iowa, has voted to sell its municipally owned distribution system to the Iowa Light, Heat & Power Company.

Fairview, Kan., has joined the ranks of private ownership by disposing of the municipal plant and distribution system to the Kansas Power & Light Company, Topeka. Fairview will be served from a high-tension line and the city's plant maintained as a standby.

Properties of the Chesterfield Electric Company, operating in Chesterfield, Medora and Rockbridge, Ill., have been transferred to the Central Illinois Public Service Company for $40,278.

The Interstate Power Company has offered $500,000 for the municipal electric plant at New Ulm, Minn., if the city will grant it a 25-year franchise.

The Fitkin interests have offered the city of Farmington, Mo., $175,000 for the municipal light and power plant. If the purchase is made, with a 20-year franchise, the purchasers would link the Farmington plant with the string of plants operated by them in Missouri and Arkansas.

The Gatineau Power Company recently added to its immense holdings on the Gatineau River by purchasing the plant of the Maniwaki Power & Telephone Company, developing 2,600 hp. at Maniwaki, Quebec, which is situated about 100 miles above Chelsea. This means that the company now controls all the sources of available electrical energy, amounting to nearly one million horsepower, in the Gatineau district.

The Quebec Southern Power Corporation has purchased La Compagnie Hydro-Electrique de l'Annonciation, which operates a hydro plant and distribution system on the Rouge River between Labelle and Mont Laurier. The Quebec Southern intends to continue to operate this plant, its fourth, until its main transmission lines are extended further north.

Illinois State Electric Association's Program

The seventh annual joint convention of the three large utility associations of Illinois—the Illinois State Electric Association, the Illinois Electric Railways Association and the Illinois Gas Association—will be held in Springfield on March 17 and 18. The morning meetings will be joint sessions and will be held at the Hotel Abraham Lincoln. The electric light and power representatives will hold afternoon sessions at the St. Nicholas Hotel. The first joint session will be addressed by leading men in the public utility industry on public relations, finance and terminable permits. The women of the industry will have a special program on Thursday afternoon, March 17, at the Hotel Leland. The Electric Association program includes these items:

"The Status of the Small Power Plant," H. T. Burgner, Illinois Power & Light Corporation.

"Reporting Transmission Line Operation to Secure Maximum Service," J. E. Hughes, Illinois Power & Light Corporation.

"Public Relations in Illinois," William A. Durgin, Commonwealth Edison Company, Chicago.

"Developing a Lighting Service Department," R. C. Tallmadge, Rockford (Ill.) Electric Company.

Symposium, "Public Relations," by Public Relations Section, Great Lakes Division, N. E. L. A.

"Sales and Merchandising Methods," Albert Clabaugh, Illinois Power & Light Corporation.

"Growing Importance of Consumers' Accounting," R. B. Tulpin, Central Illinois Public Service Company, Springfield, Ill.

Briefer News

Georgia Electrical Association to Meet in April.—The secretary of the Georgia Electrical Association, W. W. Barr of Dublin, Ga., announces that the annual convention will be held about the middle of April at the Henry Grady Hotel, Atlanta.

Baltimore Organizes Chapter of I. E. S.—The Baltimore Chapter of the Illuminating Engineers' Society has been organized by the members of the profession in that city. Charles L. Reeder will be chairman, Myrick W. Pullen, associate professor of electrical engineering at Johns Hopkins University, vice-chairman, and W. B. Masland secretary and treasurer.

Iowa Company Gets Stay in Suit to Oust It from Sac City.—An order which permits the Iowa Light, Heat & Power Company to continue operations in Sac City, Iowa, has been granted while the case is appealed to the Supreme Court. As previously reported, the company was ordered by the city to dismantle its distribution system when its franchise was not renewed.

Short Course for Women of the Electrical Industry.—A short course in electrical equipment will be given by the home economics department of the Iowa State College at Ames on March 14-19. This course, which is the first of its kind, will be open to all women interested in the electrical industry. The women's committee of the Public Relations National Section, National Electric Light Association, of which Isabell Davie is secretary, is co-operating with the college in arranging the school.

Generators for River Shannon Hydro Plant.—The initial installation at the hydro-electric station which is being built by the Siemens-Schuckert company of Berlin to utilize the water power of the River Shannon in the Irish Free State is to comprise three sets of 38,600-hp. Francis-type turbo-generators. Two of the machines are being constructed by the J. M. Voith Company, Heidenheim, Würtemberg, and one by Escher, Wyss & Company, Zurich, Switzerland.

Alabama Power Company to Build 110-Kv. Transmission Line from Martin Dam.—Immediate construction by the Alabama Power Company of a 110,000-volt transmission line from Martin Dam to the North Auburn substation on the west and to Lock 18 on the east is announced. The new circuit will be 48 miles in length and of H-frame wooden-pole construction. Extensive additions will be made to the company's Martin Dam, North Auburn and Lock 18 substations. Construction work has already begun and the work is scheduled for completion by June 1. In the

Birmingham mineral district the company will increase the capacity of its lines and substations, and in the Gadsden district and north Alabama wooden structures at important crossing points are to be replaced by steel towers.

Standard Time Difference and Lighting Peak in Michigan. — One of the benefits looked for in Michigan through the coming interconnection of the Detroit Edison and Consumers Power systems is mutual assistance in carrying the lighting peak when this becomes desirable. This can be brought about because of the fact that Detroit is on Eastern standard time while the western part of the state is on Central standard time.

Rate Reductions in Florida.—Electric rates, both residential and commercial, have been greatly reduced by the Pinellas County Power Company, according to an announcement by local officials. Residential rates have been cut from 3 to 7 per cent and commercial rates from 3 to 30 per cent. Thousands of customers throughout Pinellas County and other territory served by the company in Florida and Georgia will profit.

Forbes Public Utility Prize Contest for 1927.—Chairman W. A. Jones of the Public Relations National Section of the N.E.L.A. announces the third annual competition for a prize given by the *Forbes Magazine* for the most constructive public relations campaign carried on by a light and power company in a local territory during the past year. The contest will close on April 20, and the award will be made as usual at the N.E.L.A. convention. The previous winners were the Alabama Power Company and the Nebraska Power Company.

Rivalry for Winnipeg River Sites.—On behalf of the power interests of Manitoba, the government of that province is making application to the Ontario government for the construction of regulatory works on the English River to insure that the full flow of the Winnipeg River be utilized. The application, it is alleged, is actuated by reports that E. W. Backus and associates are seeking a power site on the English River, particulars of which are not fully known to the Manitoba interests, but which, they believe, would adversely affect the flow of the Winnipeg River, from which Manitoba now derives the bulk of its power.

Newark's Utility Office Building to Be Greatly Enlarged.—Plans are being drawn by the Public Service Production Company for an extension to the Public Service Terminal Building at Newark, N. J., which will include a fifteen-story tower at the corner of East Park and Pine Streets. Extension of the north wing of the present building along Pine Street will make a nine-story building from North Canal to East Park Street, besides the six additional stories of the tower, which will have a frontage of 86 ft. on the Pine Street side and 67 ft. on East Park Street, the height to be 213 ft. The extension will be a steel-frame structure, with pressed-brick construction and limestone and terra-cotta trim, in keeping with the present building.

North Central Division Men Meet at St. Cloud, Minn.—More than 100 persons attended a sectional meeting of the North Central Division, N.E.L.A., held at St. Cloud, Minn., recently. Wheelock Whitney, manager of the Northern States Power Company there, acted as host. John Lapham, executive secretary of the division, was one of the principal speakers. H. C. Aurun of the Westinghouse company, Minneapolis, discussed "Better Lighting."

Denver Illuminates a City Monument.—A conspicuous ornament in the City Park at Denver is the monument presented to the city by Joseph A. Thatcher, which is here shown floodlighted.

The illumination comes from eight General Electric projectors rated at 500 watts each. Credit for the photograph is due to the Denver *Post*.

Pushing Construction at Amarillo, Tex.—Over and above the $1,500,000 now being expended on the first 5,000-kw. unit of the Southwestern Public Service Company's power plant at Amarillo, in the Texas Panhandle, $2,000,000 is to be put at once into a transmission system and substations for that territory, according to General Manager L. L. Ferree. The new plant is to be completed this month, and a second unit may be added before the end of the year, at an additional cost of $1,000,000.

Three Applications for Water from Humptulips River Conflict.—Conflict is seen in three filings for water rights just made at the office of the State Hydraulics Supervisor at Olympia, Wash., relative to apportionments from the flow of the East Fork of the Humptulips River. The three applications involve undertakings aggregating $2,500,000. Aberdeen and Hoquiam have filed individual municipal applications for two projects, to cost $1,800,000, which ask water from the same source as was sought previously by William H. Hopkinson of Aberdeen for a private power and manufacturing enterprise, to cost $700,000. Aberdeen plans a domestic and industrial manufacturing water-supply system, and Hoquiam seeks water for general manufacturing and domestic uses.

Kansas Power Plants Turn to Natural Gas for Fuel.—With the piping of natural gas to Emporia, Kan., the Kansas Electric Power Company of that city has begun the use of this fuel in its power plant. The power company has taken over the Emporia Gas Company, both being Insull utilities. Within a few months it is probable that natural gas will supplant other fuels in the power plants of various cities to which pipe-line extensions are being made.

P. N. Nunn Talks of Pioneer Power Days in Utah.—Four hundred engineers and electrical men assembled in Salt Lake City recently for a joint meeting of the Electrical League of Utah, the Utah Society of Engineers and the Salt Lake Chapter of the American Institute of Electrical Engineers. P. N. Nunn, president of the Telluride Power Company and one of the pioneers in the early development of hydro-electric power in Utah, in whose honor a dinner was given prior to the general meeting, was the principal speaker and told of how obstacles were overcome in past days.

Southern California Edison Pushing Its New 220-Kv. Line.—The Southern California Edison Company has established a headquarters camp for the construction crew working on the northern half of its third 220,000-volt transmission line (the Vincent line) at Lewis Creek just east of the town of Lindsay in the San Joaquin Valley. At this camp between 250 and 300 men will be accommodated. Further north, in the Yokohl Valley, an advance camp accommodating approximately 75 men is being established. Construction crews are working from as far south as the Tule River, in a determined effort to complete the entire line from Bakersfield north early in 1928, coincident with the completion of power house No. 2-A of the Big Creek series.

Water-Power Possibilities on the Olympic Peninsula. — The Geological Survey has engaged in a preliminary investigation of the water-power resources of the Olympic Peninsula, and reconnaissance surveys of the basins of the Skokomish, Dosewallips, Hamma Hamma and Lilliwaup Rivers have been made. The results are set forth in two manuscript reports now available for inspection in the office of the Geological Survey at Washington, D. C., or Tacoma, Wash. One of these reports covers the Skokomish basin, and the other covers the Dosewallips, Hamma Hamma and Lilliwaup basins. The Skokomish basin has possibilities for considerable storage on the North and South Forks, of which Tacoma has already taken advantage, the city having built a 56,000-

hp. plant on Lake Cushman, on the North Fork, and having in contemplation a reservoir at Chimney Rock, on the South Fork, from which another 90,000 hp. would be derivable. In the Dosewallips, Hamma Hamma and Lilliwaup basins five power sites have been investigated, of which three are in the Dosewallips basin and one in each of the other basins. The water-power possibilities of these four basins at 90 per cent and 50 per cent of the time respectively are thus estimated in horsepower at 70 per cent efficiency: Skokomish, 74,000 and 86,800 (including present Cushman plant); Dosewallips, 21,000 and 36,900; Hamma Hamma, 7,650 and 14,500; Lilliwaup, 2,350 and 2,350; total, 105,800 and 140,550.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations, with their secretaries, is published in the first issue of each volume. For latest list see ELECTRICAL WORLD, Jan. 1, page 80.]

Oklahoma Utilities Association—Huckins Hotel, Oklahoma City, March 8-10. E. F. McKay, 307 Local Building, Oklahoma City.

Northwest Electric Light and Power Association, Engineering Section—Portland, Ore., March 10 and 11. O. L. LeFever, Northwestern Electric Co., Portland.

American Institute of Electrical Engineers—Southwestern District, Kansas City, March 17-18; Middle Eastern District, Bethlehem, Pa., April 21-23; Northeast District, Pittsfield, Mass., May 25-27. F. L. Hutchinson, 36 West 39th St., New York.

National Electrical Manufacturers' Association, Policies Division.—Briarcliff Manor, N. Y., March 17-18. S. N. Clarkson, 30 East 42d St., New York.

Illinois State Electric Association—St. Nicholas Hotel, Springfield, Ill., March 17 and 18. R. V. Prather, 205 Illinois Mine Workers' Building, Springfield, Ill.

Northwest Electric Light and Power Association, Accounting Section—Gasco Building, Portland, Ore., March 21. W. L. Fitzpatrick, Mountain States Power Company, Tacoma, Wash.

Southeastern Division, N.E.L.A.—Peabody Hotel, Memphis, Tenn., April 13-15. C. M. Killian, 404 Wynn-Claughton Bldg., Atlanta.

Southwestern Division, N.E.L.A.—New Orleans, April 26-29. S. J. Ballinger, San Antonio Public Service Company, San Antonio, Tex.

Southwestern Public Service Association—New Orleans, April 26-29. E. N. Willis, 403 Slaughter Bldg., Dallas, Tex.

Nebraska Section, N.E.L.A.—Grand Island, Neb., April 27-28. H. M. Davis, 1519 O St., Lincoln.

American Electrochemical Society—Benjamin Franklin Hotel, Philadelphia, April 28-30. Colin G. Fink, Columbia University, New York.

Electrical Supply Jobbers' Association—Greenbrier Hotel, White Sulphur Springs, W. Va., May 2. Franklin Overbagh, 411 South Clinton Street, Chicago.

Missouri Association of Public Utilities—Cape Girardeau, May 5-7. F. D. Beardslee, 315 North 12th St., St. Louis.

Middle West Division, N.E.L.A.—Topeka, Kan., May 18-20. H. M. Davis, 1519 O St., Lincoln, Neb.

Canadian Electrical Association—Clifton Hotel, Niagara Falls, Ont., May 25-27. J. B. Woodyatt, Southern Canada Power Company, Montreal.

National Electric Light Association—Atlantic City, N. J., June 6-10. Paul S. Clapp, 29 West 39th St., New York.

Men of the Industry

M. C. Morrow Heads N.E.M.A. Committee

M. C. Morrow, assistant sales manager of the merchandising department of the Westinghouse Electric & Manufacturing Company, has been elected chairman of the range and water-heater committee just organized by the National Electrical Manufacturers' Association. The purpose of the new committee is the co-operative solution of manufacturers' merchandising problems, and to this end it will work with a similar committee of the National Electric Light Association.

Mr. Morrow has long been associated with the electrical industry. He entered the employ of the Westinghouse company in 1900 and since 1902 has been engaged in sales activities for that company. Before his appointment

M. C. MORROW

to the position of assistant sales manager of the merchandising department, he was responsible for all sales activities in connection with the central stations. His experience in this field makes him particularly well versed in merchandising and an able director for the work of the range and water-heater committee.

C. B. Steele, formerly with the Merchants' Heat & Light Company in Indianapolis, has gone to Anderson, Ind., where he assumes the position of superintendent of the Anderson municipal light plant, succeeding Paul Ashby.

John S. Sproull, who has been connected with the Joliet office of the Public Service Company of Northern Illinois, has been appointed to act as the company's local superintendent at Morris. Mr. Sproull is an electrical engineer, having received his training at the University of Kansas.

Bertell G. Smith, formerly district manager of the Public Service Company of Northern Illinois at Chicago Heights, has been transferred in that capacity to Oak Park to succeed Harry L. Judd, who has become assistant to the vice-president in charge of public relations and service. When the Public Service Company took over the Kankakee Gas & Electric Company, Mr. Smith, who was superintendent of the electrical division of that organization, became district manager at Kankakee. He was appointed district manager at Chicago Heights in 1925.

Lawrence C. Phipps, Jr., vice-president of the Nevada-California Electric Corporation, Denver, has been chosen a member of the board of directors of the Denver Chamber of Commerce.

Paul A. Schoellkopf, president of the Buffalo, Niagara & Eastern Power Corporation, Buffalo, sailed for Europe March 1 aboard the *Conte Rosso* of the Lloyd Sabaudo line.

W. H. Fuller, who has been connected with the Florida Power & Light Company for seven years, has been named manager for the Coral Gables branch of that company.

F. E. Andrews has been appointed engineer of electrical transmission design for the Public Service Company of Northern Illinois, and **W. H. Johnson** has been named engineer of electrical distribution design of that company.

George T. Kimball, president of the American Hardware Company, New Britain, Conn., has been elected a member of the board of directors of the Connecticut Light & Power Company, Waterbury.

Herbert F. Walker, secretary and treasurer of the Canadian Fairbanks-Morse Company, was elected a vice-president of the company at a special meeting of the directors held recently. Mr. Walker entered the employ of the company in 1920 as comptroller, was appointed secretary in 1922 and secretary and treasurer in 1924. He will continue to conduct its financial affairs with the title of vice-president and secretary-treasurer.

James F. Small has been appointed district sales manager in Oak Park for the Public Service Company of Northern Illinois. Mr. Small goes to Oak Park from Chicago Heights, where until recently he was district manager for the Chicago Heights Gas Company. This organization now is a part of the Public Service Company, and Mr. Small has been active in matters having to do with the joining of the companies. In this work he has been actively associated with B. G. Smith, recently transferred from Chicago Heights to Oak Park as the Public Service district manager.

Lewis Buckley Stillwell was re-elected chairman of the Engineering Foundation for the third time at its annual meeting held in the Engineering Societies Building, New York, Feb. 17. Mr. Stillwell is a past-president of the American Institute of Electrical Engineers and the American Institute of Consulting Engineers. He is a native of Pennsylvania, a graduate of Lehigh University and a life trustee of Princeton. **Arthur D. Little**, founder and president of the Arthur D. Little Laboratories of Cambridge, Mass., and inventor of many chemical processes, was elected a vice-chairman. **George A. Orrok**, a member of the American So-

ciety of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers and the American Society of Civil Engineers, was re-elected a vice-chairman. **J. Vipond Davies,** representing the American Institute of Electrical Engineers and the American Society of Civil Engineers, and **Dean Arthur M. Greene, Jr.,** of the Princeton School of Engineering, were named again as members of the executive committee. Other officers elected were: Director and secretary, Alfred D. Flinn; treasurer, Jacob S. Langthorn; assistant treasurer, Harry A. Lardner. New members of the Foundation Board, to represent the United Engineering Society are William H. Burr, consulting engineer, formerly professor of civil engineering at Columbia University; George L. Knight of the Brooklyn Edison Company, and Alva C. Dinkey, formerly president of the Carnegie Steel Company.

J. Henry Roraback, president of the Connecticut Light & Power Company, was elected president of the Connecticut Electric Service Corporation, Hartford, to succeed Paul Thompson, acting president since the death of the late Randal Morgan of Philadelphia.

C. K. Woodbridge, formerly president and a director of the Dictaphone Corporation, New York, has been elected executive vice-president, general manager, director and a member of the executive committee of the Electric Refrigeration Corporation.

Fred D. Williams has been elected president and director of sales of the Dubilier Condenser Corporation, according to an announcement made by William Dubilier, founder of the corporation and president since its inception. Mr. Dubilier will become technical director and will devote his entire time to engineering and research.

W. D. Reinhard, formerly electrical engineer with Dwight P. Robinson & Company and more recently affiliated with the American Brass Company at Waterbury, Conn., is now sales engineer with the Anaconda Copper Mining Company, with headquarters in New York.

Russell B. Stearns and **Kenneth S. May** have been admitted to general partnership in the firm of Arthur Perry & Company, investment bankers, Boston. Mr. Stearns is a graduate of the University of Michigan and after leaving college became one of the assistants to the president of the North American Company, New York. He entered the investment banking business in Boston and became associated with the firm of Arthur Perry & Company in November, 1920. Mr. Stearns' headquarters will continue to be in Boston. Mr. May was in the class of 1909 at the Massachusetts Institute of Technology, taking the electrical engineering course. After leaving college he was successively connected with the Boston & Worcester Street Railway Company, the Boston Elevated Railway Company and for some six years with Stone & Webster in the department which conducted examinations of public utility properties for investment bankers. In May, 1916, Mr. May became associated with Arthur Perry & Company. His present headquarters are in Philadelphia.

O. H. Caldwell Appointed to Radio Commission

O. H. Caldwell, editor of *Electrical Merchandising* and *Radio Retailing,* McGraw-Hill publications, has been appointed by President Coolidge as the member of the Federal Radio Commission representing New York and New England. Mr. Caldwell was born in Lexington, Ky., in 1888 and has been active as an editor of electrical and radio magazines since 1907, when he succeeded Dr. Lee De Forest as technical editor of the old *Western Electrician,* Chicago, and its successor, the *Electrical Review.* For many years Mr. Caldwell was associate editor of the ELECTRICAL WORLD and since their establishment he has been editor of both *Electrical Merchandising* and *Radio Retailing.*

Mr. Caldwell is a graduate electrical engineer of Purdue University, where he did special work in electrical communications. He received preliminary training in Berlin, Germany. He holds

O. H. CALDWELL

the grade of member in the American Institute of Electrical Engineers and is on the radio committee of the American Engineering Council. He is a director of the New York Electrical Board of Trade and is chairman of surveys for the general merchandise committee of the National Electric Light Association. Besides membership in numerous electrical bodies, he belongs to the Lotos Club, New York, and the Indian Harbor Yacht Club, Greenwich, Conn.

Arnold J. Mitchell has been appointed service manager of the Public Service Company of Northern Illinois at Joliet. Mr. Mitchell has been in the employ of the Public Service Company since 1911.

B. E. Jack, district sales manager at Salina, Kan., for the United Power & Light Corporation, Abilene, has resigned to accept a position with the Kansas Gas & Electric Company, Wichita.

Samuel M. Stone, vice-president of the Hartford (Conn.) Electric Light Company, was recently elected a director of the Connecticut Mutual Life Insurance Company of Hartford to succeed the late Shiras Morris. Mr. Stone is also president and director of the Colt Patent Fire Arm Manufacturing Company, a director of the American Screw Company, director of the Humason Manufacturing Company, vice-president of the Hartford Steam Boiler Inspection & Insurance Company, president of the Johns-Pratt Company and the Phoenix State Bank & Trust Company. He is a director of the American Reserve Insurance Company and a trustee of the Dime Savings Bank.

Frank Parkins has been appointed sales manager of the Nebraska Power Company, Omaha, Neb., to succeed K. P. Goewey, resigned. Mr. Parkins has been assistant to Mr. Goewey for the past five years.

Frank J. Cottrill, who has been district sales manager of the Wisconsin Power & Light Company at Fond du Lac, prior to which he was commercial manager of the Iowa Railway & Light Company at Cedar Rapids, has been promoted to succeed Mr. Gerg as division commercial manager. Mr. Cottrill will be in charge of the commercial activities of the company in Fond du Lac, Sheboygan, Oshkosh and some smaller communities.

W. A. Rezeau, formerly manager of the United Power & Light Corporation's interests at Florence, Kan., has become associated with the Western Light & Power Company at Conway Springs, it has been announced by Nathan L. Jones, Salina, president of the latter company. Conway Springs is the company's operating headquarters.

G. E. Sullivan, for eleven years district manager at Oregon City, Ore., for the Portland Electric Power Company, has been appointed division sales manager for the Portland division of the company, a new position in the commercial department under A. C. McMicken, general sales manager. Mr. Sullivan's service with the company began in vacation periods before the completion of his schooling. After his graduation from the University of Oregon in 1909 he entered the engineering department of the then existing Portland Railway, Light & Power Company. His aptitude for executive and commercial tasks led to his transfer on Dec. 1, 1915, to be district manager at Oregon City, where he remained until his recent promotion.

Obituary

Edward Carpenter Wood, president of the Mica Insulator Company of New York, Chicago and Schenectady, died Feb. 17 in New York. A pioneer in the mica insulation industry, Mr. Wood played an important part in the development of micanite, which was first put on the market by the Mica Insulator Company in 1893. Mr Wood had been identified with the Mica Insulator Company since its inception in 1893.

Benjamin Carpenter, a director of the Commonwealth Edison Company, Chicago, died Feb. 22 at his home in that city after a two years' illness. Mr. Carpenter was a native of Chicago and a graduate of Harvard University. At the time of his death he was president of George B. Carpenter & Company, ship chandlers, and was identified with other industrial organizations. Mr. Carpenter was 61 years of age.

Commission Rulings

Cost of Service as a Factor in Rate Making.—The Wisconsin Railroad Commission has recently held in a case affecting Milwaukee that under a statute which merely provides that rates shall not be unjust or unreasonable or unjustly discriminatory rates for municipal waterworks need not exactly reflect the cost of service. The commission said that there was no attempt in the statute to denominate as unjustly discriminatory a rate which may not conform strictly to the cost of service, and that the statute seemed to contemplate that the commission might properly consider all factors having a bearing upon rates and not merely the question of the cost of serving a particular class. The commission declared that so much emphasis had been laid upon the determination of the cost of service for different classes of users that in some quarters this cost has come to be looked upon as the sole or most important element to be considered in fixing a schedule. This probably was largely an outgrowth of the hit-and-miss method of fixing rates in the early days of the utility business. It seemed to the commission that to hold that rates must be fixed rigidly on that basis would read into the statute something which might well have been expressed in definite terms if it had represented the legislative intent. The commission held that it was not bound to fix rates in accordance with the cost curve, and, further, that some consideration might properly be given to the managerial functions of the city in the determination of the type of schedule.

Uniform Rate for Domestic Service Found Equitable for Cooking.—A complaint by users of electricity for cooking against the substitution of a single rate for all residence service in lieu of one rate for cooking and a higher rate for lighting and household appliances was not sustained by the Pennsylvania Public Service Commission. To take advantage of the low cooking rate it was necessary for the consumer to install at additional expense a separate circuit in his home and have a separate meter placed therein, and separate bills for cooking were rendered. Thus by the installation of the cooking circuit it was possible, under the schedule of existing rates, greatly to reduce the bill for domestic energy consumption. Wide variations in the bill could occur, depending upon the availability of the cooking circuit and the technical knowledge of the patron, rather than upon the difference in the character of service. As a means of correcting this inequality, the company filed a single rate applicable to domestic service. Under the new rate only one billing can be had for a given use of energy. The complainants objected to a resulting increase in bills for cooking. Out of a total of approximately 200 consumers who had received service under the old cooking rates, the change increased the monthly charge of about 130 to the total extent of approximately $440 a year. On the other hand, a large number of consumers benefited by aggregate reductions of about $3,600, a net saving to all patrons of about $3,200. In view of these circumstances the commission held that it would not be just or reasonable to set aside the new rate and thus compel the patrons as a whole to pay higher charges. To sustain the new rate for the majority but require a different rate for a minority adversely affected would perpetuate the complexities and inequalities of the old system and maintain lower rates for a special group of customers.

Recent Court Decisions

Indiana Public Service Commission Law Upheld.—The Circuit Court at Logansport, Ind., has refused to grant the city of Logansport an injunction against the Indiana Public Service Commission restraining it from enforcing a cut in electric light rates on the ground that the Public Service Commission law is unconstitutional. (See ELECTRICAL WORLD for Dec. 18, 1926, page 1292.) The city will appeal to the Supreme Court of the state.

Negligence in Transmission-Line Construction a Question for Jury.—In Helms vs. Citizens' Light & Power Company damages were sought because of the death of a telephone lineman who came into contact with a high-tension transmission line uninsulated and strung 8 ft. or 10 ft. above a telephone wire on which the lineman was working. The Supreme Court of North Carolina upheld a judgment for the plaintiff. In this case a telephone wire was said to have broken loose from the pole to which it was attached and to have flown up and touched the transmission wire. It was testified that no protection against an accident of this sort had been installed, and the court held that the question of the company's negligence was properly submitted to the jury. (136 S. E. 9.)*

Irrigation Districts May Use Funds to Lobby.—The right of the Imperial Irrigation District to lobby for the passage of the Swing-Johnson bill has been upheld by the California Supreme Court, reversing a decision of the Supreme Court, rendered in 1925, that the payment of funds from the treasury of the district to promote passage of the bill was illegal. The latter decision was handed down in a test case brought by D. R. Crawford, a taxpayer, to restrain B. F. Fly, who had been engaged to go to Washington as the personal representative of the district for the purpose of advocating the passage of the Boulder Canyon measure, from acting in that capacity. The Supreme Court draws a distinction between "personal, secret or sinister influence" and "open advocacy of a cause." The irrigation district body, the court holds, is not wholly a municipal corporation and has broad powers. It is entitled to contract with the United States government for the acquisition of water rights and is entitled to show cause.

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

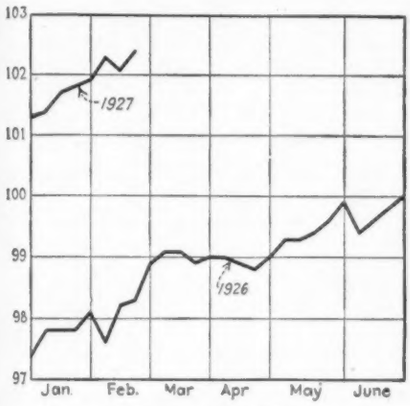
Maryland Municipality Cannot Sell Property Without Legislative Permission.—The question in Worcester Electric Company, Snow Hill Electric Light & Power Company, Mayor of Snow Hill and Maryland Public Service Commission vs. Hancock (four separate appeals) concerned the right of the municipality of Snow Hill, Md., without an act of the Legislature to dispose of its interest in the Snow Hill Electric Light & Power Company, which the city holds under a contract of sale dated July 14, 1924, and authorized by the Legislature. The act provided that nothing therein should be construed as relieving the Mayor and Council of Snow Hill from any of the provisions of the Public Service Commission law, and the Court of Appeals of Maryland holds that when property is held by a municipality in trust for the use and benefit of its citizens and is dedicated to the use of the public, then the law will not permit the corporation to divest itself of the title without special authority of the Legislature. The powers of the Public Service Commission, the court emphasizes, are of a regulatory nature. There is nothing in the acts of the General Assembly giving jurisdiction to the commission to authorize a sale by a municipality of property dedicated to public use.

Ten-Year Average-Price Method of Valuation Disapproved. — Ruling that the methods under which the Wisconsin Railroad Commission fixed the valuation of the Waukesha Gas & Electric Company (now part of the Wisconsin Gas & Electric Company) for rate-making purposes were "confiscatory and unreasonable," the Wisconsin Supreme Court reversed the decision of a lower court and set aside a decision issued by the commission in 1922 ordering a reduction in gas rates from $2.10 per 1,000 cu.ft. to $1.85. The valuation of the properties was fixed at $335,000 by the commission, whereas the company claimed $554,000. A refund of $17,000 would have been made to gas consumers in Waukesha had the Supreme Court affirmed the lower court's decision. The Supreme Court held that present cost of reproduction less depreciation, the method of valuation fixing approved by the United States Supreme Court, was admittedly more accurate than the system followed by the Wisconsin Railroad Commission, which adhered to the rule that present value should be determined on average prices for a period of ten years prior to the time of hearing. The court held further that "a valuation which does not as to the tangible property substantially reflect the then cost of reproduction less depreciation does not meet the requirements, and consequently where there has been a period of rising prices for many years original cost plus cost of additions and improvements does not correctly measure the present valuation."

Financial and Statistical

Utility Trading Revives Slightly Some Common Stocks Up Bond Levels Far Above Last Year

"BIG board" issues of the power and light companies have made two or three attempts during the past week to join the broad trading activity of the markets, but gains have been small. Although a few utility issues are favored for trading purposes continuously, the major interest is still elsewhere. The same is true of the smaller exchanges.



AVERAGE PRICE OF TEN POWER AND LIGHT BONDS

Two or three common stocks, however, have made substantial gains during the week. Edison Electric Illuminating of Boston, Pacific Gas & Electric and Public Service of New Jersey are examples. In the counter trading General Gas & Electric participating certificates were the feature. The average of fifteen common stocks of power and light companies computed by the ELECTRICAL WORLD gained one point over last week, to 95. Gains were in the majority over losses, but most of the issues remained unchanged.

Preferred stocks have not shown any marked activity during the week. Price averages, in fact, have changed little for several weeks.

Bonds, however, continue to reach new high levels. Whether or not the present ease in the money market is destined to continue much longer is a matter of conjecture. It seems to be the consensus of opinion that most factors point to still greater ease in money and still higher bond prices. In any event it is difficult to note any indications of a change in the present upward trend. Along with railway and industrial issues public utility bonds have climbed steadily to levels which are higher than at any time since before the war. This movement has been little affected by the large volume of new bond financing, which has been readily absorbed by the growing body of investors among the public, and by institutions. Bond prices usually move up or down with the stock market, but with the present ease of money there seems little relationship between the two markets. Present prices of ten representative power and light bonds, in comparison with prices at this time last year, are shown in the accompanying chart.

Record Output of Central Stations

Figures for December, 1926, Show a Total Revenue of $155,000,000 —More than 6,326,000,000 Kw.-Hr. Generated

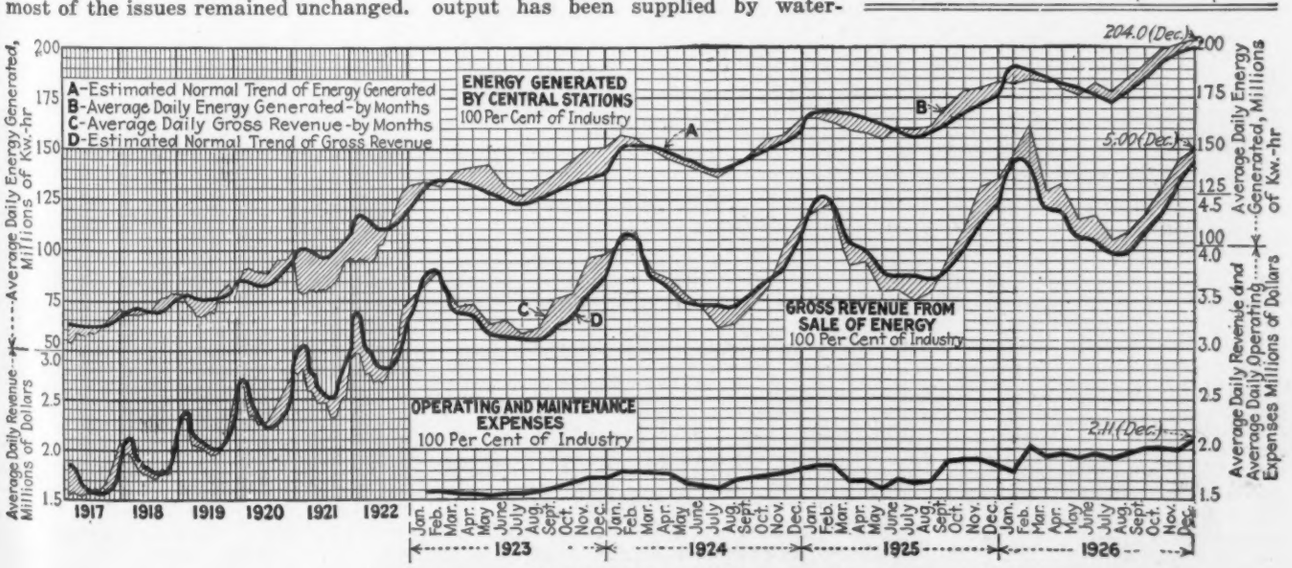
AS TO both revenue and energy output, all monthly records for central-station operations in the United States were broken in December, 1926. The revenue, $155,000,000, exceeded that of December, 1925, by 11.7 per cent. The output, 6,326,857,000 kw.-hr., was correspondingly greater by 10.6 per cent. Compared with November, 1926, there was an increase in output of 5 per cent and a slightly higher increase in revenue. The change is a normal one for the season of the year. The highest record of the previous winter, established in February, 1926, was $145,000,000. This was slightly exceeded in November and has now been passed by $10,000,000.

The output from hydro-electric plants continues to show large gains over the corresponding months of 1925, amounting to 14.4 per cent for November, 21.0 per cent for December and about 18.2 per cent for the half year. These extraordinarily high percentages indicate that a large fraction of the additional output has been supplied by water-power plants. The increase of energy generated from fuel was therefore smaller, the percentages being 11.1 for November, 5.4 for December and 9.2 for the half year.

Meanwhile the plant efficiency shows further marked improvement. The 5.4 per cent increase in output was secured at an added cost of only 1.2 per cent in coal consumption and with a decrease of 3 per cent in oil and 7.7 per cent in gas consumption. The 9.2 per cent

TABLE I—OPERATING RATIO OF CENTRAL-STATION COMPANIES

	Operating Ratio					
	Steam Plants		Hydro Plants		Combined Hydro and Steam Plants	
	1926	1925	1926	1925	1926	1925
July	51.6	53.6	34.1	32.5	44.9	45.8
Aug.	51.8	51.5	38.7	36.0	44.8	45.3
Sept.	49.3	50.0	40.0	40.7	43.3	46.0
Oct.	47.7	48.6	35.2	37.8	44.0	44.3
Nov.	44.5	44.3	34.5	33.5	41.9	42.8
Dec.	43.4	45.5	36.7	35.5	40.8	42.6



AN AVERAGE OF 204,000,000 KW.-HR. DAILY IN DECEMBER

TABLE II—GENERATION AND DISTRIBUTION OF CENTRAL-STATION ENERGY IN THE UNITED STATES
(100 per Cent of the Industry)

Month	Kw.-Hr. Generated Monthly*			Estimated Distribution of Energy Generated										Energy Purchased by Public Utilities for Resale, Kw.-Hr.	
				Total Energy Consumption by Central-Station Customers, Kw.-Hr.		Energy Consumed for Lighting, Kw.-Hr.		Energy Consumed for Power, Kw.-Hr.		Energy Sold to Electric Railways, Kw.-Hr.		Energy Used in Intracompany Business, Including Line Losses, Kw.-Hr.			
	1926 Thousands	1925 Thousands	Per Cent Inc.	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands
July	5,562,172	4,966,266	+12.0	4,489,172	4,009,266	1,164,000	1,079,000	2,761,172	2,384,266	564,000	546,000	1,073,000	957,000	1,010,000	730,000
August	5,777,753	5,085,379	+13.6	4,662,753	4,102,379	1,212,000	1,123,000	2,886,753	2,433,379	564,000	546,000	1,115,000	983,000	1,103,000	753,000
September	5,825,852	5,125,410	+13.6	4,700,852	4,136,410	1,188,000	1,102,000	2,966,852	2,506,410	546,000	528,000	1,125,000	989,000	1,190,000	797,000
October	6,174,959	5,550,289	+11.2	4,981,959	4,478,289	1,262,000	1,168,000	3,149,959	2,760,289	570,000	550,000	1,193,000	1,072,000	1,240,000	955,000
November	6,053,635	5,391,857	+12.3	4,883,635	4,349,857	1,300,000	1,202,000	3,033,635	2,615,857	550,000	532,000	1,170,000	1,042,000	1,200,000	996,000
December	6,326,857	5,714,067	+10.6	5,106,857	4,611,067	1,360,000	1,258,000	3,176,857	2,803,067	570,000	550,000	1,220,000	1,103,000	1,130,000	1,050,000
Total for six months	35,721,228	31,833,268	+12.2	28,825,228	25,687,268	7,486,000	6,932,000	17,975,228	15,503,268	3,364,000	3,252,000	6,896,000	6,146,000	6,873,000	5,281,000

*Data on "energy generated" are those collected and published by the United States Geological Survey for all public utilities minus such data as are collected on energy generated by electric railway companies, reclamation service and manufacturing plants. The data are, therefore, for the electric light and power industry only.

increase in energy generated from fuel during the half year required only 2.9, 5.0 and 3.8 per cent, respectively, additional consumption of the three fuels named. Expressing all fuels in terms of the heat equivalent of coal, the consumption per kilowatt-hour was well under 2 lb.

The December increase in revenue over the corresponding month of 1925 was more marked in the East than in other parts of the country, approximating 13 per cent in the Atlantic Coast States, 7 in the North Central region and about 10 in the remainder of the country, with somewhat more favorable conditions in the Far West.

A review of the returns for the six months shows that the energy output was 12.2 per cent higher and the revenue 12.3 per cent higher than for the corresponding period of 1925. During the latter part of the year there has been a gradual decrease in the percentage of the former from 13.6 in August to 10.6 in December. Increase in revenue changed similarly from 13.7 in September to 11.7 in December. Compared with 1925, the revenue had its low point in November and rose again in December.

In the light of the industrial activity of 1925, particularly the latter part of that year, it is not surprising that the extraordinary gains recorded during the early part of 1926 should have been slightly moderated in the latter part of the year. A maintained rate of growth averaging more than 12 per cent for a half year is, after all, a pretty rapid pace for any industry.

Brooklyn Edison Stockholders Authorize Increase.—Stockholders of the Brooklyn Edison Company have authorized the increase in capital stock referred to in the Feb. 26 issue of the ELECTRICAL WORLD from $75,000,000 to $100,000,000. At the meeting the company's fifteen directors were re-elected.

New Capital Issues

During the first week of March the Public Service Electric & Gas Company, Newark, N. J., issued first and refunding mortgage, 5 per cent gold bonds to the amount of $19,800,000, the price being 99 and interest, to yield about 5.06 per cent. The purpose of this issue of bonds, dated June 1, 1925, and maturing June 1, 1965, is to provide a part of the funds required for the purchase of the new Kearny power plant and appurtenant property, constructed at a cost of approximately $33,000,000, and for refunding purposes in accordance with the provisions of the mortgage. The $63,071,000 first and refunding mortgage bonds which will

TABLE III—CENTRAL-STATION FINANCIAL OPERATIONS FOR FOUR MONTHS IN THE UNITED STATES
(100 per Cent of the Industry)

Month	Total Gross Revenue from Sale of Energy†			Estimated Distribution of Gross Revenue								Total Operating and Maintenance Expenses‡	
				Lighting Customers		Power Customers		Electric Railways		Other Public Utilities			
	1926 Thousands	1925 Thousands	Per Cent Inc.	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands
July	$127,200	$112,300	+13.3	$81,100	$73,700	$33,400	$28,400	$4,500	$4,300	$8,200	$5,900	$59,300	$54,250
August	127,800	113,500	+12.6	81,300	75,200	33,600	28,300	4,300	4,200	8,600	5,800	59,400	53,200
September	132,300	116,300	+13.7	82,600	76,100	35,600	29,640	4,450	4,220	9,650	6,340	60,150	54,100
October	141,300	126,000	+12.1	88,400	81,100	38,400	33,300	4,600	4,400	9,900	7,200	61,700	56,300
November	147,000	132,800	+10.6	94,000	87,700	38,400	32,600	4,600	4,400	10,000	8,100	60,650	54,400
December	155,000	138,700	+11.7	98,000	91,000	42,000	34,400	4,800	4,600	10,200	8,700	65,300	60,300
Total for six months	$830,600	$739,600	+12.3	$525,400	$484,800	$221,400	$186,640	$27,250	$26,120	$56,550	$42,040	$366,500	$332,550

†Aggregate gross revenue from actual consumers, and sales to other public utilities for resale, involving a certain amount of duplication.
‡Do not include interest, taxes, depreciation or sinking fund.

TABLE IV—OPERATIONS OF CENTRAL-STATION HYDRO AND FUEL PLANTS IN THE UNITED STATES*
(100 per Cent of the Industry)

Month	Energy Generated						Fuel Consumption								
	Hydro-Plants			Fuel Power Plants			Coal			Oil			Gas		
	1926 Thousands of Kw.-Hr.	1925 Thousands of Kw.-Hr.	Per Cent Increase	1926 Thousands of Kw.-Hr.	1925 Thousands of Kw.-Hr.	Per Cent Increase	1926 Short Tons	1925 Short Tons	Per Cent Increase	1926 Barrels	1925 Barrels	Per Cent Increase	1926 Thousands of Cubic Feet	1925 Thousands of Cubic Feet	Per Cent Increase
July	1,971,199	1,835,021	+ 7.4	3,590,973	3,131,245	+14.6	2,993,960	2,771,100	+ 8.0	671,984	814,718	—17.5	5,056,094	4,180,741	+20.9
August	2,062,629	1,735,369	+18.8	3,715,124	3,350,010	+10.9	3,060,647	2,975,728	+ 2.9	728,864	723,310	+ 1.2	5,403,316	4,801,130	+12.5
September	2,033,312	1,579,591	+28.5	3,792,540	3,545,819	+ 6.9	3,114,535	3,081,516	+ 1.1	883,913	769,918	+14.8	4,816,955	5,091,882	— 5.4
October	2,122,336	1,769,058	+19.9	4,052,623	3,781,231	+ 7.2	3,317,113	3,295,768	+ 0.6	879,929	811,475	+ 8.4	4,872,740	4,503,408	+ 8.2
November	2,192,963	1,915,694	+14.4	3,860,672	3,476,163	+11.1	3,198,202	3,062,335	+ 4.4	930,044	744,011	+25.0	3,910,311	4,182,000	— 6.5
December	2,356,637	1,946,949	+21.0	3,970,220	3,767,118	+ 5.4	3,396,173	3,350,689	+ 1.2	758,263	761,140	— .3	3,390,065	3,671,437	— 7.7
Total for six months	12,739,076	10,781,682	+18.2	22,982,152	21,051,586	+ 9.2	19,074,630	18,537,136	+ 2.9	4,852,997	4,621,572	+ 5.0	27,449,481	26,430,598	+ 3.8

*As collected by United States Geological Survey. The data are for the electric light and power industry only

be outstanding upon completion of this financing will be secured by first mortgage on the new Kearny power plant of 205,100 kva. installed capacity and the Essex power plant of 200,600 kva. installed capacity and on other physical properties and by direct mortgage, subject to $21,842,132 underlying liens on the remainder of the company's physical property; also by pledge of valuable leasehold estates and certain underlying and leased companies' securities.

The National Public Service Corporation issued 100,000 shares of class A common stock during the week under review. Proceeds will provide additional money for expansion, improvement and other general corporate purposes.

Three-Million-Dollar Foreign Loan Floated

Thirty-year gold debentures bearing 6½ per cent interest were offered the investing public by the International Power Company, Ltd., to the amount of $3,000,000, the price being 100 and accrued interest. The International Power Company, incorporated under the laws of the Dominion of Canada, controls public utility properties in Bolivia, British Guiana, Newfoundland, Porto Rico, Salvador and Venezuela.

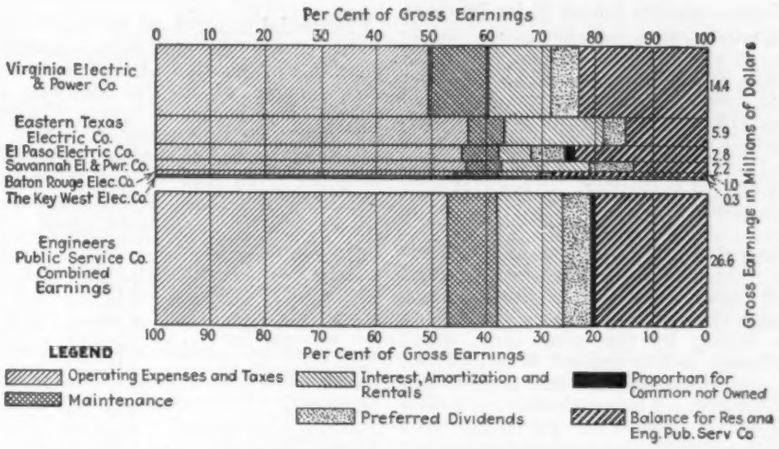
These debentures, dated March 1, 1927, and maturing March 1, 1957, will be a direct obligation of the company and will be issued under an indenture which will include a provision that debentures in excess of the amount of first preferred stock at any time outstanding may be issued only under certain restrictive conditions. This issue of debentures is made for the purpose of providing for the construction of extensions and improvements to the properties controlled by the company and for the acquisition of shares of the Porto Rico Railways Company, Ltd.

Central Arizona Company Changes Set-up.—The Central Arizona Light & Power Company, operating the light, power and gas utilities in Phoenix, Ariz., has been rechartered by the Arizona Corporation Commission. Assent has been given to amendments to the articles of incorporation, increasing the capital stock to 350,000 non-par-value shares, 50,000 to be preferred, with annual return per share of either $7 or $6, as the directors may decide. The commission has been asked to ratify the sale of 7,500 shares of seven-dollar preferred stock at not less than 96, and the exchange of 200,000 shares of the new common stock for 40,000 shares of the old.

Associated Gas to Redeem 6 per Cent Issue.—All of its 6 per cent secured gold bonds, series of 1925, due Jan. 1, 1955, have been called for payment by the Associated Gas & Electric Company on April 1, the redemption price to be 105 and interest. Holders of these securities are offered the privilege of exchanging them for $6.50 preferred stock of the company on the basis of ten shares of stock and check for $75 for each one-thousand-dollar bond, or eleven shares of stock for each one-thousand-dollar bond plus $22.50 cash.

Engineers' Public Service Balance up 26 per Cent

Consolidated Gross Earnings of Company and Subsidiaries Show 15 per Cent Gain—Some Important Financing by Company Carried on During Year


Per Cent of Gross Earnings
0 10 20 30 40 50 60 70 80 90 100
Virginia Electric & Power Co.
Eastern Texas Electric Co.
El Paso Electric Co.
Savannah El. & Pwr. Co.
Baton Rouge Elec. Co.
The Key West Elec. Co.
Engineers Public Service Co. Combined Earnings
14.4
5.9
2.8
2.2
1.0
0.3
26.6
Gross Earnings in Millions of Dollars
100 90 80 70 60 50 40 30 20 10 0
Per Cent of Gross Earnings
LEGEND
Operating Expenses and Taxes
Maintenance
Interest, Amortization and Rentals
Preferred Dividends
Proportion for Common not Owned
Balance for Res. and Eng. Pub. Serv. Co.

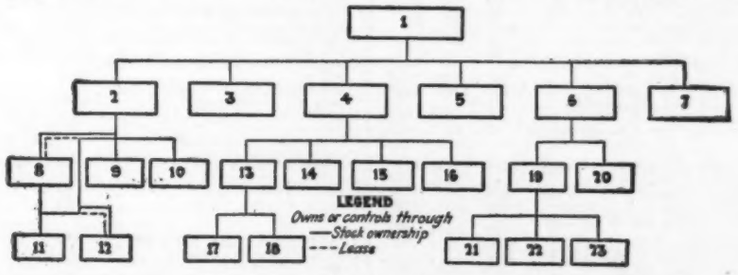
ANALYSIS OF INCOME OF ENGINEERS' PUBLIC SERVICE COMPANY AND SUBSIDIARIES

A RISE of 26 per cent in balance available for reserves and for common dividends is the main feature of the annual statement of the Engineers' Public Service Company. The report, just issued, is one of the most lucid and complete of the public utility financial statements. Various relationships in the set-up and in the earnings statement are thrown into percentages so that their importance in the statement can be readily seen.

Analysis of the company's earnings statement shows that operating expenses and taxes took 62 per cent of gross earnings. Maintenance amounted to 9 per cent and taxes 7.1. Net earnings of $10,112,319 were 28 per cent of gross, and the balance available for reserves and for Engineers' Public Service common dividends amounted to 12 per cent of gross—an advance of approximately 26 per cent over last year's figure. Light and power accounted for 56.8 per cent of gross earnings, transportation for 31.4 per cent, gas for 4.9 and miscellaneous for 6.9. In comparison with this, light and power accounted for 66 per cent of the balance, transportation for 21.9 per cent, gas for 4.8 and miscellaneous items for 7.3. Light and power operations show the largest percentage of gross in balance available.

Capitalization figures show 305,018 shares of preferred stock and 778,938 shares of common. There are also 2,623 shares of preferred and 200,000 of common reserved for delivery under allotment certificates and option warrants. The company has no funded debt. Total assets of the company amount to $154,673,974.

The consolidated earnings statement of the company and its subsidiaries shows an increase of 15.2 per cent in annual gross earnings over those published in the previous report, which was for twelve months ended Feb. 28, 1926. Part of this increase was due to the acquisition of the Baton Rouge Electric Company, but, eliminating this, the increase still amounts to 11.1 per cent. The gain in gross earnings for all subsidiaries, including Baton Rouge, for 1926 amounts to 16.6 per cent. The net return shown by the properties for the year was less than 6½ per cent of



CORPORATE SET-UP OF ENGINEERS' PUBLIC SERVICE COMPANY

1. Engineers' Public Service Company.
2. Virginia Electric & Power Company.
3. Key West Electric Company.
4. Eastern Texas Electric Company.
5. Savannah Electric & Power.
6. El Paso Electric Company.
7. Baton Rouge Electric Company.
8. Norfolk Railway & Light.
9. Virginia-Carolina Power Company.
10. Commonwealth Ice Company.
11. City Gas Company of Norfolk.
12. Upper Appomattox Company.
13. Western Public Service Company.
14. Eastern Texas Electric Company.
15. Gulf States Utilities Company.
16. Louisiana Electric Company, Inc.
17. Tarkio (Mo.) Electric & Water Co.
18. Mound City Electric Light & Ice Company.
19. El Paso Electric Company (N. J.)
20. Mesilla Valley Electric Company.
21. El Paso & Juarez Traction Company.
22. El Paso Electric Company (Texas).
23. Rio Grande Valley Traction Company.

their net book value. Dividend and interest earnings of the parent company were approximately the same as its own requirements for preferred dividends, operating expenses and taxes. All further earnings were left for investment in the property of subsidiaries.

Commonwealth Edison Votes Increase in Capitalization.—At the annual meeting of stockholders of the Commonwealth Edison Company held Feb. 28 the authorized capitalization was increased from $125,000,000 to $150,000,000. J. J. Mitchell, Jr., son of the chairman of the Illinois Merchants' Trust Company, was elected a director. Other directors were re-elected.

Recent Listings.—First and refunding mortgage 5 per cent sinking-fund gold bonds, series A, of the Montana Power Company have been authorized for listing by the New York Stock Exchange to the amount of $1,500,000, making the total amount applied for $27,985,000. Also authorized for listing on the New York Exchange were additional first mortgage and refunding 5 per cent gold bonds, series A, of the Niagara, Lockport & Ontario Power Company, totaling $3,750,000. This makes the total amount applied for $18,750,000. There were recently authorized for listing 104,870 shares of 7 per cent cumulative preferred stock (par $100) of the Virginia Electric & Power Company and temporary certificates for 27,796 shares of 6 per cent cumulative preferred stock (par $100). Capital stock of the Safety Cable Company — not exceeding 36,998 shares without par value—has been authorized

Annual Reports Show Progress

Financial reports of the power and light companies currently appearing show a continuation of the substantial development which the industry has shown for a period of years. Comparing last year's progress with that of previous years, the rate of increase both in gross and in net is approximately equivalent to that of the past three years. Some of the larger companies show a much greater increase, but this is due, frequently, to the purchase of other companies and does not represent a corresponding growth in the industry. The following earnings statements were issued this week:

Name of Company	Gross Earnings Twelve Months Ended Jan. 31 1927	1926
Alabama Power	$13,384,058	$11,936,140
Bangor Hydro-Electric	1,745,799	1,597,128
Binghamton Lt., Ht. & Pwr.	1,946,186	1,700,454
Carolina Power & Light*	8,176,683	6,957,656
Central Illinois Light	4,221,519	3,921,782
Cent. Illinois Pub. Service*	12,744,077	11,626,618
Central Maine Power	5,186,281	4,921,470
Commonwealth Edison*	65,776,058	58,691,584
Commonwealth Power	49,473,699	44,708,222
Consumers Power	24,305,770	20,997,098
Federal Light & Traction*	6,623,587	5,888,708
Florida Public Service	1,701,794	1,123,302
General Gas & Electric	24,369,351	21,070,008
Illinois Northern Utilities*	3,078,753	2,763,428
Metropolitan Edison	9,673,405	8,737,809

Name of Company	Gross Earnings for Twelve Months Ended Jan. 31 1927	1926
National Public Service*	27,788,680	23,258,871
New Jersey Power & Light	2,465,591	1,477,656
No. Carolina Public Service	2,125,871	1,867,534
Northern Ohio Power	12,048,922	11,568,324
Ohio Edison	1,834,707	1,584,217
Penn-Ohio System*	12,733,683	11,314,523
Portland Electric Power	11,817,801	11,096,469
Public Service Co. of Northern Illinois*	23,311,198	20,646,820
Republic Railway & Light*	12,733,683	11,314,523
Southern California Edison*	27,846,518	24,832,402
So. Indiana Gas & Electric	2,902,500	2,684,851
Tennessee Electric Power	11,885,410	11,638,805
Virginia Electric & Power*	14,362,066	12,624,135

* Year ended Dec. 31, 1926 and 1925.

Stock Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday March 1	Low 1927	High 1927
ABITIBI PWR. & PAPER, 4% com.—no par	88	83	90
Adirondack Pwr. & Lt.—7% pf.	107½	101*	108½*
Adirondack Pwr. & Lt.—8% pf.	113	101*	115*
Ala. Pwr., 7% pf.	109½	....	....
Allis-Chalmers Mfg., 7% pf.	k109	....	....
Allis-Chalmers Mfg., 6% com.	97½	88	97½
Aluminum Co. of Amer., com.	k72½	70½	73
Aluminum Co. of Amer., 6% of	k102	101½	102½
Amer. & Foreign Pwr., pf. 25% pd.	m110	....	....
Amer. & Foreign Pwr., 7% pf.—no par	88½	86½	89½
Amer. & Foreign Pwr., com.—no par.	21	18½	23
Amer. Bosch Magneto, com.—no par	18½	13	18½
Amer. Brown Boveri Elect.	36	34½	39½
Amer. Brown Boveri Elec., pf. $7.	k 94½	95½	98
Amer. Gas & Elec., 6% pf.—no par.	96½	95½	98½
Amer. Gas & Elec., com.†—no par.	71½	68½	100½
Amer. Lt. & Trac., 6% pf.	112	105*	132*
Amer. Lt. & Trac., com.†	234½	224½	235
Amer. Pwr. & Lt., 6% pf.	99½	97½	100½
Amer. Pwr. & Lt., com.†—no par.	59½	54	61½
Amer. Pub. Serv., 7% pf.	98	92*	97½*
Amer. Pub. Serv., com.†	50	45*	80*
Amer. Pub. Utilities, 7% pr. pf.	89	86*	95*
Amer. Pub. Utilities, 7% pfc. pf.	70	73*	89*
Amer. Pub. Utilities, com	m66	68*	82*
Amer. States Sec., A	3½	2*	9½*
Amer. States Sec., B	3½	1½*	5½*
Amer. Superpwr., $6 pf.—25.	k 27½	26½	28½
Amer. Superpwr., 7% pf., ex. div.	i 93½	....	....
Amer. Superpwr., Class A†—no par.	28½	27½	29½
Amer. Superpwr., Class B†—no par.	29½	28½	30
Amer. Wtr. Wks. & Elec., 7% pf.	104½	104½	110½
Amer. W. W. & E., com. $1.20—20.	77½	62½	78½
Anaconda Copper Cap. $3.	48	45	49½
Appalachian Electric Pwr., 7% pf.	99	90*	101*
Appalachian Elec. Pwr., 2d pf., 7%	98	99*	102*
Appalachian Elec. Pwr., com.	m78	....	....
Arizona Pwr., 7% pf.	79	60*	82*
Arizona Pwr., com.	23	....	....
Arkansas Cent. Pwr., pf.—$7 no par.	k101	99*	107*
Arkansas Lt. & Pwr., 7% pf.	102	96*	104*
Arkansas Lt. & Pwr., com.	100	110*	115*
Assoc. Gas & Elec., $3.50—50.	52	....	....
Assoc. Gas & Elec., pf.—$6—no par.	87½	79½*	86½*
Assoc. G. & E., Class A, $2.50—no par	40½	35	41½
BABCOCK & WILCOX, 7% com.	k117	115½	118
Binghamton L., H. & P., $6 pf.	91	90*	95*
Birmingham Elec., pf.—$7—no par.	106½	101*	108*
Blackstone Valley G. & E., $6 pf.	102	103*	106*
Blackstone Valley Gas & Elec., 10% com.—50	97½	100½*	106*
Blaw-Knox, com.†	i 70	70	73
Brazilian Trac., Lt. & pwr., com.†	f121	....	....
Broad River Pwr., 7% pf.	97½	93*	98*
Brooklyn Edison, 8% com.	152½	148½	154½
Buffalo, Niagara & East. Pwr., pf.—25	i 25½	....	....
Buffalo, Niagara & East. Pwr. com.† —no par	27½	27½	28½
CALIFORNIA ELEC. GENERATING, 6% pf.	96	89*	95*
California Ry. & Pwr., 7% pf.	120	88*	130*
Carolina Pwr. & Lt., pf.—$7—no par	f107½	107	108½
Central & S.W. Util., 7% pf.—no par	a 95	93½	96½
Central & S.W. Util., pr. In. $7 pf.—no par	a99	92	99½
Central Ariz. Lt. & Pwr., 7% pf.	95	....	....
Central Ark. Ry. & Lt., 7% pf.	101	99*	101*
Central Ill. Pub. Serv., 6% pf.	k 86	89*	91*
Central Ind. Pwr., 7% pf.	87	84½*	93½*
Central Pwr. & Lt., 7% pf.	102	94*	103½*
Central States Elec., 7% pf.	93	....	....
Central States Elec., com.†	m200	200*	230*
Century Elec., 6% com.	m117	110*	117*
Chicago Fuse Mfg., com.—$2.50 no par	a 32	....	....
Cincinnati Gas & Elec., 5% com.	g 94½	93½	95½
Cities Service, 6% pf.	i 91½	91½	92½
Cities Service, pf. B—10.	i 8½	8½	8½
Cities Service, pf. BB—100.	i 85	82	85
Cities Service, com.—20.	i 58	50½	58½
Cities Service, Bks. Shrs.—10.	i 29	25	29½
Clarion River Pwr., 8% pf.	95	93*	95*
Cleveland Elec. Illg., 6% pf.	108	103*	109*
Cleveland Elec. Illg., 10% com.	300	240*	310*
Colorado Pwr., 7% pf.	k 95	96*	97*
Columbia Gas & Elec., 6% pf.	101	99½	101½
Columbia G. & E. com. $5—no par.	86½	82½	91½
Columbia Ry., Gas & Elec., 6% pf.	94	65*	96*
Columbus Elec. & Pwr., 2d. pf.	106	....	....
Columbus Elec. & Pwr., 9% com.	66½	....	....
Columbus Ry., Pwr. & Lt., 6% 1st pf.	97	98*	99½*
Columbus Ry., Pwr. & Lt., 6½% pf. B	98	....	....
Columbus Ry., P. & L. com.—no par	70	70*	85*
Commonwealth Edison, 8% com.	a141½	....	....
Commonwealth Pwr., 6% pf.	k 92½	82*	93½*
Commonw'th Pwr., $2, com.—no par	46½	42½	47½
Conn. Lt. & Pwr., 8% pf.	119	117*	121*
Conn. Lt. & Pwr., 7% pf.	112	108*	113*
Cons. Gas of N. Y., pf.†—50.	55½	57*	62½*
Cons. Gas of N. Y., com $5—no par.	100	97½	109½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6% pf.	k105	102*	107*
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6½% pf.	e112	....	....
Cons. Gas, Elec. Lt. & Pwr. of Balti., 7% pf.	k111	109	115
Cons. Gas, Elec. Lt. & Pwr. of Balti., 8% pf.	e128	....	....
Cons. Gas, Elec. Lt. & Pwr. of Balti., com. $2.50—no par.	e 51½	....	....
Consolidated Pwr. & Lt., 7% pf.	106	100*	107*
Consumers Pwr., 6% pf.	101½	95*	101½*
Consumers Pwr., 6% pf.	104½	101½*	106*
Continental Gas & Elec., 7% pfc. pf.	105	96*	109½*
Continental Gas & Elec., 7% pr. pf.	102	95½*	101½*
Contl. G. & E. com. $4.40—no par.	220	85*	210*
Crocker Wheeler, com.†	36	....	....
Crocker Wheeler, 7% pf.	84	....	....
DALLAS PWR. & LT., 7% pf.	107	....	....
Dayton Pwr. & Lt., 6% pf.	101½	95*	100*
Detroit Edison, 8% com.	k137	133½	137½
Dubilier Condenser, com.—no par.	m 3½	3½	4
Dubuque Elec., 6% pf.	103	93*	98½*
Duquesne Lt., 7% pf.	k115	114½	116½
EASTERN NEW YORK UTIL., $7 pf.	102	80*	104*
Eastern New York Util. com.	65	70*	75*
Eastern States Pwr., $7, com.	12	12*	32½*
Eastern States Pwr., pf.	93	89*	95*
East. Tex. Elec., 7% pf.	106	100*	107*
East. Tex. Elec., com. $5—no par.	90	70*	80*
Edison Elec. of Boston, 12% com.	d225	....	....
El Paso Elec., com. $5—no par.	70	70*	94*
El Paso Elec., 7% pf.	106	102*	106½*
Elec. Bond & Share, 6% pf.	f107½	107½	109
Elec. Bd. & Sh. Sec., fcom. $1—no par	i 69	67½	72½
Electric Household Util. †	a 12½	11	14½
Elec. Investors, 6% pf.—no par.	92½	87*	95*
Elec. Investors, com.†—no par.	34½	32½	37
Elec. Investors, 10% pd. receipts.	15	12*	56*
Elec. Pwr. & Lt., ctfs. pf.	99½	96	99½
Elec. Pwr. & Lt., ctfs., 40% pd.	k105½	103½	105½
Elec. Pwr. & Lt., ctfs, full pd.	k106	102½*	110½*
Elec. Pwr. & Lt., ctfs., com.—no par.	18½	16½	18½
Elec. Refrig. cap.†	34½	30½	37½
Elec. Ry. Securities, com.—no par.	88½	....	....
Elec. St. Battery com. $5.25—no par	75½	72½	79½
Elmira Wtr., Lt. & R.R., 7% pf.	100	97½*	101½*
Emerson Elec., pf.	m105	101*	105*
Empire Pwr., A $6	28	....	....
Engr. Pub. Serv., $7 pf.—no par.	99	93½	99
Engr. Pub. Serv., com.—no par	m 23½	21½	24½
Eureka Vacuum Cleaner, com. $4—no par	65½	60½	67½
FAIRBANKS MORSE, 7% pf.	k108	107½	110
F.-M., com.—$2.60—no par.	k 41	35½	42½
Federal Lt. & Trac., com.†	43½	37½	44½
Federal Lt. & Trac. 6% pf.	92½	91½	95
Ft. Worth Pwr. & Lt., 7% pf.	f108½	108	112
GALVESTON-HOUSTON ELEC. 6% pf.	75	65*	70*
Galveston-Houston Elec., com.	26½	....	....
Gen. Elec., 8% com.	86½	81	87½
Gen. Elec., special—10.	11½	11½	11½
Gen. Gas & Elec. (Del.) com. A. $1.50—no par	46½	39	47½
Gen. G.&E. (Del.) com. B—no par.	42½	39	43½
Gen. G.&E. (Del.) pf. A. $8—no par.	k114	115	115½
Gen. G.&E. (Del.) pf. A $7—no par.	k102½	100	107½
Gen G.& E. (Del.) pf. B $7.	k 97	96	98½
Gen. Pub. Serv., $7 pf.	k103	102*	106*
Gen. Pub. Serv., com.	k 13½	11½	14½
Ga. Lt., Pwr. & Rys., 6% pf.	90	82*	98*
Ga. Lt., Pwr., & Rys., com.	m 60	65*	80*
Ga. Ry. & Pwr., 8% pf.	k120	112*	122*
Ga. Ry. & Pwr., 7% pf.	107½	100½*	108½*
Ga. Ry. & Pwr., 4% pf.	m119	....	....
Ga. Ry. & Pwr., 4% com.	120	....	....
Gt. Western Pwr., 7% pf.	h103	....	....
IDAHO PWR., 7% pf.	104	103	105
Ill. No. Utilities, 6% pf.	k 88	88*	92*
Ill. Pwr. & Lt., 7% pf.	100	96½	100½
Ingersoll Rand com. $8.	k 93½	92	95½
Int. Combus. Engr., com. $2—no par	64	43½	64
Int. Util., Class A—$3.50—no par.	31½	28	31½
Int. Utilities, Class B—no par.	4	3	5½
Interstate Pwr., pf.—$7—no par.	94	90*	98*
Interstate Pub. Serv., 7% pf.	99	96½*	99½*
Iowa Ry. & Lt., 7% pf.	96	98*	100*
JERSEY CENTRAL PWR. & LT., 7% pf.	98	94*	98½*
Jersey Cent. Pwr. & Lt., 7% pfc. pf.	111	95½*	112*
Jersey Cen. Pwr. & Lt., com.—no par	k 25	25*	50*
Johns-Manville, com.†—no par.	k 61½	55½	65

Stock Exchange: aChicago; bSt. Louis; cPhiladelphia; dBoston; eBaltimore; fMontreal; gCincinnati; hSan Francisco; iPittsburgh; jWashington. kBid price Saturday, Feb. 26. lBid price Wednesday, March 2. mLatest quotations available. *1926. †Dividend rate variable.

for listing by the New York Stock Exchange on official notice of issuance in exchange for the property of the American Insulated Wire & Cable Company and of the Brenner-Mervis Company, or on official notice of issuance and payment in full, making the total amount applied for 200,000 shares.

Pittsfield Electric Stock to Be Exchanged. — Stockholders of the Pittsfield (Mass.) Electric Company have been notified of a plan to exchange shares for shares of the Western Massachusetts Companies, organized in January as a holding company for electric utility companies of western Massachusetts. The stockholders in a letter are informed that the move is of a protective nature. The holding company's stock has no par value, but is expected to yield $2 a share per year. Each share of Pittsfield Electric Company stock will be exchanged for seven shares of the holding company's stock.

Banks a Growing Market for Securities

Savings Banks Now Hold Almost Billion in Public Utility Securities—Can Absorb Millions More

NOTWITHSTANDING the current abundance of investment funds available to the power and light industry, the probable growth of future sources of capital is a vital question. Recently published statements of the growth of the nation's wealth and of bank deposits provide clues. It was estimated in these columns recently that savings banks now hold about a billion dollars' worth of utility securities and that national banks have about half this amount. Anticipation of a rapid growth in these holdings seems amply justified. There is a gradual strengthening of the utilities and their financial structures. There is a growing volume of investment funds for which the banks must find safe and remunerative occupation. Legislative enactments are enabling an increasing amount of these funds to flow into the utilities.

On the other hand, savings banks in ten of the savings bank states are forbidden to invest in public utility securities, and among the states where such investment is permitted the rigid restrictions given in the table on page 530, expressed in percentage of total deposits, must be adhered to.

Laws already enacted making these securities legal investment provide, in general, that the company must be subject to the supervision of a public service or other regulatory commission and must carry on at least 80 per cent of its business within the United States.

Stock Quotations of Electric Light and Power and Manufacturing Companies (Continued)

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday March 1	Low 1927	High 1927
KANSAS CITY PWR. & LT. pf.$7	112	112	1¼
Kansas Gas & Elec., 7% pf.	i104	103	104
Kentucky Hydro-Elec., 7% pf.	a 95½	....	....
Kentucky Sec.,6% pf.	82	75*	85*
Kentucky Sec., 5% com.	107	90*	108*
Kentucky Utilities, 6% pf.	95	90*	96½*
Keystone Pwr. & Lt., 7% pf.	96½	95*	98½*
LACLEDE GAS LT., 8% com.	184½	173½	189½
Lehigh Pwr. Sec., com.—no par.	17½	15	18
Long Island Ltg., 7% pf.	107	....	....
Long Island Ltg., com. $2—no par.	140	120*	150*
Los Angeles Gas & Elec., 6% pf.	99	95½*	100*
Louisville Gas & Elec., cl. A. $1.75	26½	23½	26½
MAN. ELEC. SUPPLY, cap. $4.25 —no par	64½	53½	65
Manila Elec., com.†—no par.	£ 40	40	44
Maytag Mfg., com. .50—no par.	26½	23½	28
Memphis P. & L., pf.—$7—no par	107½	103*	110*
Metropolitan Ed., pf.—$6—no par.	95	91½*	98*
Metropolitan Ed., pf.—$7—no par.	103½	102*	108*
Metropolitan Ed., com. $5—no par.	60	....	....
Middle West Utilities, 7% pf.	a109½	....	....
Middle West Util., 7% pr. lien pf.	a118½	....	....
Middle West Util., com. $6—no par	a109½	....	....
Midland Utilities, pr. ln. 7% pf.	a101½	....	....
Midland Utilities, 7% pf. A.	a 98	97	99½
Milwaukee Elec. Ry. & Lt., 7% pf.	£100	100*	103*
Milwaukee Elec. Ry. & Lt., 6% pf.	£ 99	87*	100*
Minn. Pwr. & Lt., 7% pf.	i104½	104	105
Miss. Pwr. & Lt., $8 pf.	108½	102*	107½*
Miss. River Pwr., 6% pf.	96	93*	96*
Miss. River Pwr., com.	62	....	....
Mohawk Hudson Pwr., 1st pf.—$7 —no par.	99½	....	....
Mohawk Hudson Pwr., 2d pf.—$7 —no par.	£ 99	90*	102*
Mohawk Hudson Pwr., com.—no par	24½	20½	27
Montana Pwr., 7% pf.	m119½	118½	119½
Montana Pwr., 4% com.	88	81½	89½
Montreal Pwr., 7% com.	f 74½	....	....
Mountain States Pwr., 7% pf.	99	97*	102*
Mountain States pwr., com.†	18	....	....
NASSAU & SUFFOLK LTG., 7% pf.	102	93*	101*
National Carbon, 8% pf.	m130	124*	130*
National Elec. Pwr., A†	24	23½	25½
National Elec. Pwr., 7% pf.	a 95½	93*	95*
National Lt., Ht. & Pwr., com.	24	22*	25*
National, Light, Ht. & Pwr., 5% pf.	70	71*	73*
National Pwr. & Lt., pf.—$7—no par	103	....	....
National Pwr. & Lt., com.†—no par.	21½	19½	22
National Pub. Serv., 7% pf.	95	87½*	95*
National Pub. Serv., 7% pfc., pf.	113	96*	112*
National Pub. Serv., A com. $1.60— no par	21½	18½	21½
National Pub. Serv., B com.—no par	15½	14	16½
Nebraska Pwr., 7% pf.	i107	106	108½
Nevada-Calif. Elec., com.	m 25	25	26½
New Brunswick Pwr., 7% pf.	55	30*	60*
New Eng. Pub. Serv., pr. ln. pf. $7..	100	98*	101*
New Eng. Pub. Serv., pf. $7.	95	95½*	97*
New Orleans Pub. Serv.—7% pf.	104	100*	105*
N. Y. & Queens Elec. Lt. & Pwr., 5% pf.	90	89*	95*
N. Y. Central Elec., 7% pf.	102	98*	100*
Newport News & Hampton Ry., Gas & Elec., 5% com.	109	98*	112*
Newport News & Hampton Ry., Gas & Elec., 7% pf.	109	98*	114*
Niagara Falls Pwr., 7% pf.—25.	28½	27½	29
Niagara, Lock. & Ont. Pwr., 7% pf.	111	110*	111½*
No. Amer., 6% pf.—50.	51½	50	51½
No. Amer., com.—10.	50½	45½	50½
No. Amer. Edison, $6 pf.—no par.	£ 98	90½	100½
No. Caro. Pub. Serv., pf.—$7—no par	94	89*	96*
Northeastern Pwr., com.	16½	16½	18½
No. Indiana Gas & Elec., 7% pf. A.	103	98*	103½*
No. N. Y. Utilities, 7% pf.	104	....	....
No. Ohio Pwr., com.—no par.	12½	9½	13½
No. Ohio Trac. & Lt., 6% pf.	80	78*	81*
No. Ohio Trac. & Lt., 7% pf.	90	88*	96*
No. Ont. Lt. & Pwr., 6% pf.	86	75*	88½*
No. Ont. Lt. & Pwr., 4% com.	74	73*	78*
No. States Pwr., (Wis.) 7% pf.	103	....	....
No. States Pwr., (Del.) 8% com.	112½	109½	113½
No. Texas Elec., 6% pf.	74	48*	65*
No. Texas Elec., 4% com.	35	....	....
OHIO BRASS, com. B $4—no par.	82	70*	80*
Ohio Brass, 6% pf.	100	98*	101*
Ohio Gas & Elec., 7% pf.	95	90*	95*
Ohio Pwr., 6% pf.	97½	90*	97*
Ohio Pub. Serv., 6% pf.	895	94½	95
Ohio Pub. Serv., 7% pf.	i105	103½	105
Ohio River Edison, 7% pf.	104½	98½*	105*
Oklahoma Gas & Elec., pf.	95	....	....
PACIFIC GAS & ELEC., 6% pf.	24½	....	....
Pacific Gas & Elec., 8% new com.	32½	31	33
Pacific Pwr. & Lt., 7% pf.	i103	102	104
Parr Shoals Pwr., 6% pf.	92	90*	97½*
Penn Cent. Lt. & Pwr., $5 pf.—no par	c 73	71½	73
Penn-Ohio Edison, 6% pf.	98½	80½	82
Penn-Ohio Elec., 7% pf.	95	93*	96*
Penn-Ohio Pwr. & Lt., 7% pf.	98	94*	100*
Penn-Ohio Pwr. & Lt., 8% pf.	107	100*	111*
Penn Pwr. & Lt.—$7—no par.	i108	107	108½
Penn Pub. Serv., 6% pf.	90	85	90
Penn Wtr. & Pwr., 8% com.	a180	176	185
Phila. Co., 6% pf.—50.	£ 51½	50	53
Phila. Co., com.—50.	£ 91½	85½	92
Phila. Elec., 8% com.—25.	c 47½	....	....
Portland Elec. Pwr., 7% pf.	98	97*	101*
Portland Elec. Pwr., 6% pf.	81	71*	87*
Portland Elec. Pwr., 6% 2d pf.	65	71*	75*
Portland Elec. Pwr., com.	25	26*	48*
Potomac Elec. Pwr., pf.	j108½	....	....
Pwr. Corp of N. Y., com. $1—no par	m79	77½*	90½*
Pwr. Sec., pf.—no par.	£ 30	10*	39*
Pwr. Sec., com.—no par.	£ 5	4*	13*
Public Serv. of Colorado, 7% pf.	j 99	99	99
Pub. Serv. of N. J., 7% pf.	£110½	108½	110½
Pub. Serv. of N. J., 8% pf.	£126½	125	126½
P. S. of N. J., $5 com.—no par.	35½	32	35½
Pub. Serv. of No. Ill., 6% pf.	a104	102	105
P. S. of No. Ill., com. $8—no par.	a134½	130½	136
Pub. Serv. of No. Ill., 8% com.	a134	132	136
Pub. Serv. of Okla., 7% pf.	99	92*	100*
Pub. Serv. Elec. & Gas, 6% pf.	k£104½	102	105½
Pub. Serv. Elec. Pwr., 7% pf.	£114½	113½	115
Puget Sound Pwr. & Lt., 7% pf.	105	103*	108*
Puget Sound Pwr. & Lt., 6% pf.	84	82*	84½*
Puget Sound Pwr. & Lt., com.	31	....	....
RADIO CORP. OF AMER., pf.—50	52½	50½	53
Radio Corp. of Amer., com.—no par.	56½	47½	56½
Republic Ry. & Lt., pf.	£118	95*	120*
Republic Ry. & Lt., com.	122	75*	116*
Rochester Gas & Elec., 6% pf. D.	101½	98*	102*
Rochester Gas & Elec. 7% pf. C.	101½	....	....
Rochester Gas & Elec., 7% pf.	106	105*	107*
SAFETY CABLE, com. $4.	62	52½	62
San Joaquin Lt. & Pwr., 7% pf.	106	97½*	108*
St. Joseph Ry., L., H. & P., 5% pf.	70	60*	70*
Servel Corp.	£ 9½	7½	9½
Sierra Pacific Elec., com.	24	....	....
Sioux City Gas & Elec., 7% pf.	100½	96*	101½*
Southeastern Pwr. & Lt., pf.—$7 no par.	i102½	....	....
Southeastern Pwr. & Lt., $6 pfc. pf.	j 70½	....	....
Southeastern Pwr. & Lt., com.—no par.	30½	29½	32½
So. Calif. Edison, 8% pf.	36½	32½*	36*
So. Calif. Edison, 7% pf.	28½	27½	28½
So. Calif. Edison, 6% pf.	£ 24½	24½*	25*
So. Calif. Edison, 8% com.	34½	31½	34½
Southern Cities Utilities, 7% pf.	82½	....	....
Southern Cities Utilities, com. $4.	25	....	....
Southwestern Lt. & Pwr., A $3.	63	52*	60*
Southwestern Lt. & Pwr., B.	63	38*	58*
Southwestern Lt. & Pwr., $6 pf.	85	75*	82*
Southwestern Pwr. & Lt., 7% pf.	£105	100*	105*
Springfield (Mo.) Ry. & Lt., 7% pf.	97	95*	100*
Standard Gas & Elec., 8% pf.	59½	57½	60
Standard Gas & Elec., 7% pf.	105½	....	....
Standard G. & E., com. $3—no par.	56½	54	57½
Standard Pwr. & Lt., 7% pf.	96	90*	98½*
Staten Island Edison, pf.—$6—no par.	98	93*	97½*
Superheater, $6 com.—no par.	£173	138*	173*
Syracuse Lighting, 7% pf.	102	105*	107*
Syracuse Lighting, 8% pf.	115	....	....
Syracuse Lighting, 8% com.	300	260*	355*
TAMPA ELEC., com. $2.	57½	....	....
Tenn. Elec. Pwr., 6% pf.	93½	87*	90*
Tenn. Elec. Pwr., 7% pf.	105½	98*	105*
Terre Haute, Ind. & East. Trac., 5% pf.	20	20*	37*
Terre Haute, Ind. & East. Trac., com	1	1*	7*
Tex. Pwr. & Lt., 7% pf.	i107½	106	108
Tide Water Pwr., 8% pf.	105	101*	106*
Timken Roller Bear., com.—$4 no par.	92½	78	95½
Toledo Edison, 8% pf.	i115	114	115
Toledo Edison, 7% pf.	i105½	104	105½
Toledo Edison, 6% pf.	j 95	94½	95
Toledo Edison, 6% com.	100	....	....
Tri-City Ry. & Lt., 6% pf.	96	87½*	90*
UNITED GAS & ELEC., 6% pf.	98	94*	97*
United Gas & Elec., com.—no par.	m57	56*	66*
United Gas & Elec., (N. J.) 5% pf.	70	70*	75*
United Gas Impr., 8% com.—50.	c 91	....	....
United Lt. & Pwr., pf.—$4—no par.	50	44*	53*
United Lt. & Pwr., pf.—$6.50—no par.	90	81*	91*
United L. & P., com. A .48—no par.	13½	12½	15½
United L. & P., com. B .48—no par.	£ 16	13*	29*
Utah Pwr. & Lt., 7% pf.	i105	104	105
Utica Gas & Elec., 7% pf.	105	103*	106*
Utica Gas & Elec., 8% com.	200	....	....
Utilities Pwr. & Lt., 7% pf.	93	92*	98*
Utilities Pwr. & Lt., com. A $2.	30½	27	30½
Utilities Pwr. & Lt., com. B $1—no par.	14½	13½	15½
VERMONT HYDRO-ELEC., 7% pf.	97	93	98
Virginia Elec. & Pwr., 7% pf.	106	104	107
Virginian Pwr., 7% pf.	108	102*	104*
Virginian Pwr., com.	70	65*	75*
WAGNER ELEC., 7% pf.	£ 70	68	74
Wagner Elec., com.†—no par.	£ 21	18½	24
Washington Ry. & Elec., 5% com.	j205	....	....
Washington Ry. & Elec., 5% pf.	j 91	....	....
Washington Wtr. Pwr., 8% com.	138	130*	138*
West Mo. Pwr., 7% pf.	m92	....	....
West Penn Elec., 7% pf.	106½	102	107½
West Penn Elec., Cl. A $7.	£102½	97½	103
West Penn Pwr., 7% pf.	113½	111	114
West Penn Pwr., 6% pf.	m102	100½	103
West Virginia Lt., Ht. & Pwr., 7% pf.	93	95*	98*
West Va. Utilities, 7% pf.—50.	50	42	51
Western Pwr., 7% pf.	101	....	....
Western States Gas & Elec., 7% pf.	95½	89*	94½*
Western States Gas & Elec., com.	19	....	....
Westinghouse Elec. & Mfg., 8% com. —50.	74½	67½	75½
Weston Elec. Instrument, Cl. A $2.01 —no par.	£ 33	30½	34½
Weston Elec. Instrument, com.—no par.	18	15	18½
Wheeling Elec., 6% pf.	96	91*	97*
Wis., Pwr., Lt. & Ht., 7% pf.	£ 95	85*	91*
Worthington Pump, 7% pf. A.	£ 54½	46	54½
Worthington Pump, 6% B.	£ 44½	40	45
Worthington Pump, com.	31	20½	31½
YALE & TOWNE com. $5—25.	£ 74½	70½	75

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RESTRICTIONS UPON UTILITY INVESTMENTS

	Total Limit, Per Cent	In Any One Company, Per Cent
Connecticut	15	2
Maine	35	2
Massachusetts	15	2
New Hampshire	75	5
New Jersey	20	..
Vermont	25	2

It is usually required that the franchise must cover at least 75 per cent of gross income and must run for at least three years after the maturity of the bonds. That the funded debt shall not exceed 60 per cent of actual book value of fixed property is sometimes stipulated. Gross revenues must be at least $1,000,000 and net earnings must be double interest charges for at least a five-year period. There must be a closed underlying mortgage, secured by property owned and operated by the company, or else an open mortgage which provides for the issue of additional bonds to an amount not more than 75 per cent of costs. Most provisions allow a refunding mortgage providing for the retirement of all prior liens.

Beyond these general restrictions, there are various individual state requirements. The New Jersey law, for example, provides that the mortgage shall be a lien on fixed assets and that the total of bonds outstanding shall not exceed two-thirds of book value. Gross operating revenues under the New Jersey law shall have averaged not less than $2,500,000 annually for three years and net revenue for the same period must have been at least two and one-half times average interest requirements.

An Expanding Market

At present there are about 600 mutual savings banks in the country, with invested funds of at least $7,500,000,000. Deposits in New York State alone amount to $3,500,000,000. Under the suggested act this would allow investment well over $500,000,000 in these securities. Taking the country as a whole, there are outstanding probably $5,000,000,000 to $6,000,000,000 of power and light bonds. The annual addition to this total is about $750,000,000, or 15 per cent of the smaller figure. New York and Massachusetts alone could probably absorb one year's utility bonds, were the former allowed so to invest. This illustrates the size of the market in relation to the volume of offerings.

Two trends are obviously essential to assure a gradual widening of this market for utility securities. One is a gradual observance of and conformity to these requirements by the companies. The other is liberalizing of the requirements to meet changing conditions. Both of these tendencies are in evidence, and for this reason it is anticipated that the commercial and savings banks of the country will constitute a growing market for public utility securities.

Los Angeles Gas & Electric Bonds on Legal List.—The California State Superintendent of Banks has certified as legal investment for savings banks in California the recent ten-million-dollar issue of Los Angeles Gas & Electric Corporation first and general mortgage bonds, series of fives, due 1961.

Consolidated Gas Stockholders Vote Stock Increase. — Stockholders of the Consolidated Gas Company of New York have approved the plan to increase the authorized common stock from 3,600,000 shares to 4,320,000 shares and in addition to create an issue of 3,000,000 shares of new no-par-value preferred stock.

New Light and Power Issues Total $166,000,000

NEW offerings of electric light and power issues during the month of February, including stocks, bonds and debentures, amounted to $166,000,000, as compared with $223,859,000 in January and $55,194,000 in February, 1926. In the first two months of the current year the central stations have raised $389,859,000 by the sale of new securities, against $223,827,242 for the similar period of the preceding year. Only thirteen companies participated in the new financing, so that the substantial total in February resulted from the volume of the issues rather than the number. The largest individual offering was made by the Associated Gas & Electric Company in the form of convertible gold debentures to the amount of $40,000,000.

Incidentally, it is interesting to note the prominence of that type of security of late.

As has already been remarked in the ELECTRICAL WORLD, last year 15 per cent of all capital raised was secured through the sale of debentures and among the issues sold this year so far the percentage is still higher. In addition to the Associated issue in February were the Standard Power & Light, the Interstate Power, the Cities Service and the North Continent Utilities Companies.

Attention is called to the activity of refunding operations. The average yield advanced from 5.45 per cent in January to the 5.69 per cent mark in February. Long-term financing predominated.

Security Issues of Electric Service Companies in February

Name of Company	Amount of Issue	Period Years	Class	Purpose	Interest Rate	Price	Per Cent Yield
Community Power & Light Co.	$11,000,000	30	First mortgage collateral gold bonds.	To retire existing funded indebtedness and for other corporate purposes.	5	95½	5.30
Lexington Utilities Co.	3,750,000	25	First and refunding mortgage gold bonds.	To retire bonds, to reimburse the company for additions and for other corporate purposes.	5	96½	5.25
Rhode Island Public Service Co.	15,000,000	..	Cumulative preferred stock.	.....	..	30	6.66
Northwestern Public Service Co.	5,800,000	30	First mortgage gold bonds, series A.	To retire outstanding bonds, to reimburse treasury for construction expenditures and to provide an adequate medium for future financing.	5	96¼	5.25
Associated Gas & Electric Co.	40,000,000	50	Convertible gold debentures	To retire indebtedness, to acquire new properties for new construction and for other corporate purposes.	5½	95⅝	5.75
	4,050,000	..	Class A stock.	.....	..	40½	....
North Continent Utilities Corp.	2,000,000	15	Convertible sinking fund gold debenture bonds.	To acquire securities and to finance construction of new plant.	6½	100	6.50
Southwest Public Service Co.	900,000	10	First mortgage gold bonds, series A.	.....	6½	99½	6.56
Los Angeles Gas & Electric Corp.	10,000,000	34	First and general mortgage gold bonds.	To redeem bonds and for extensions and additions to plants and systems.	5	98½	5.09
Standard Power & Light Corp.	24,000,000	30	Gold debentures.	To refund notes and debentures.	6	99½	6.03
Interstate Power Co.	20,000,000	30	First mortgage gold bonds.	To retire securities, to permit consolidation of properties and for other corporate purposes.	5	97½	5.16
	7,500,000	25	Gold debentures.	.....	6	98½	6.10
Eastern Gas & Electric Securities Corp.	200,000	20	Collateral trust gold bonds, series A.	Acquisition of stocks of operating companies and for various other corporate needs.	6	100	6
	300,000	..	Preferred stock.	.....	7	100	7
Southwestern Light & Power Co.	6,500,000	30	First mortgage gold bonds, series A.	To retire bonds for the acquisition of property, to reimburse treasury for expenditures on additions and for other corporate purposes.	5	97	5.20
Cities Service Co.	15,000,000	39	Refunding gold debenture bonds.	To retire bonds	5	91⅞	5.53
Total	$166,000,000	..					

Manufacturing and Markets

Increasing Manufacturers' Load Factor

Closer Co-operation Between Central-Station Companies and Manufacturers Offers Many Possibilities in Reducing Costs—Industry's Record Justifies Steadier Buying

THE rate of flow of business—the load factor—is the manufacturers' worst condition. He is today where the central-station companies were 25 years ago, when they had a morning and evening peak. They have since prospered by filling up the valley, by serving a diversity of demand and by creating a proper relation between investment and average production. Future economies will depend on refinements of standards and on economic stabilization, which must take the manufacturer into consideration. A study of the curve (Fig. 2) depicting the growth of the electrical industry would indicate that theoretically the manufacturer should never be out of work. The other curves are obtained from the records of a manufacturer, are typical and illustrate the necessity for a high plant investment to meet a business which spread over a larger period of time would result in the need for less plant capacity and consequently smaller investment requirements for the same capital turnover. The consumption of electrical energy is the basis of the manufacturer's production, and it is an economic waste for the manufacturer under the unusual healthy conditions prevailing to be forced to accept business at a rapidly varying rate.

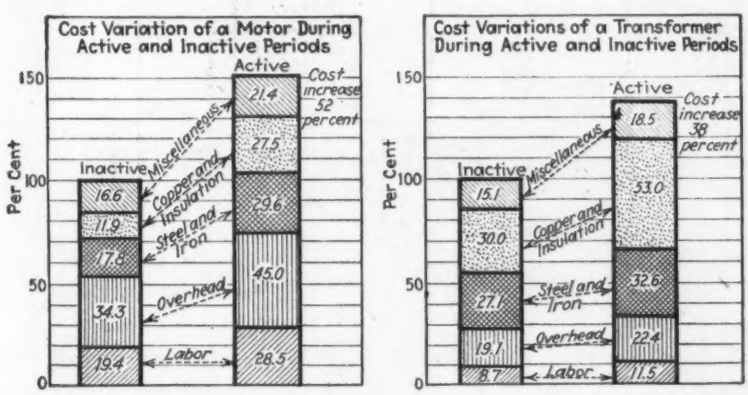


FIG. 1—PRODUCTION COSTS OF APPARATUS INCREASE DURING ACTIVE PERIODS

About 50 per cent of the cost of a commodity is a product of the volume. Legal expenses, administration, sales expenses and similar items bear a fixed ratio to investment regardless of the amount of business. During the last few years manufacturing capacity has grown at the rate of about 7 or 8 per cent a year, which was necessary to meet peak loads, but one manufacturer predicts that were his production load factor increased to the point which is apparently feasible, it would be possible, without any further increase in plant facilities, to take care of the business for the next ten years. The business of the industry has quadrupled in the last ten years, and the manufacturer has kept abreast of the demands of the country, but it has been possible to do this only in a most extravagant way.

EFFECTS OF NON-UNIFORM VOLUME

The manufacturer must have a more even flow of orders. He cannot give the service nor make the prices or profit that he should on the feast-or-famine basis of former years. For instance, in 1921 a manufacturer laid off 12,000 men, most of them skilled workmen, because buying had stopped despite the trend of central-station growth in previous years. A few months later in 1922 all companies started buying together, and the largest amount of construction work ever undertaken was begun. It was a question then not only of hiring 12,000 more men, but also 5,000 more in addition, and naturally production fell about six months behind requirements.

BENEFITS OF UNIFORM LOADING

Results from such conditions are anything but satisfactory and are an economic waste. The product is none too good, and prices must stiffen because costs increase. Analyzing this situation, we find that the following benefits would accrue with uniform plant loading:

1. Increased labor efficiency through retaining a trained force.
2. Reduced labor turnover: (a) Less defective work; (b) less tool abuse; (c) reduced employment expense; (d) reduced training expense.
3. More contented workmen: (a) Because their jobs are more stable; (b) because earnings are larger through higher efficiency.
4. Less capital investment.
5. Less handling expense because equipment layout is more closely knit.
6. Unfinished stores investment is better controlled.
7. Better and more simplified inspection.
8. Less expense for demurrage, expressage and material chasers.
9. Less production at high prices, more at low prices.
10. Reduced clerical overhead.
11. Less supervisory expense per man.

ERRATIC BUYING

Some buyers now feel that manufacturers should increase their facilities for building turbo-generator units. This is attacking the problem from the wrong angle, with benefit to but one branch of the industry. If turbines were purchased at more regular intervals, the entire industry would reap the benefit. As an illustration, in 1925 the whole steam-turbine business of the country amounted to 1,900,000 kw.; in 1924 it was 1,300,000 kw., and in 1923 it was 3,100,000 kw. In a short period the turbo-generator business showed a fluctuation from $2,500,000 in one year to $20,000,000

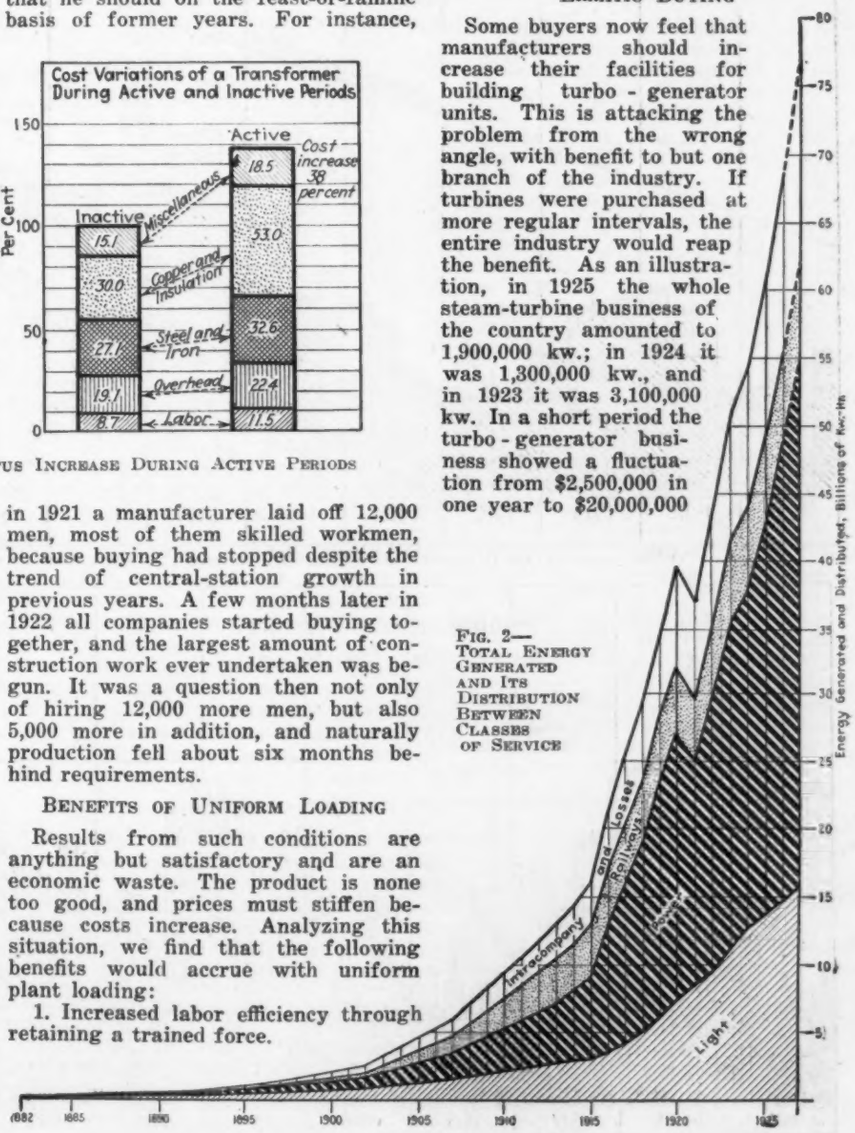
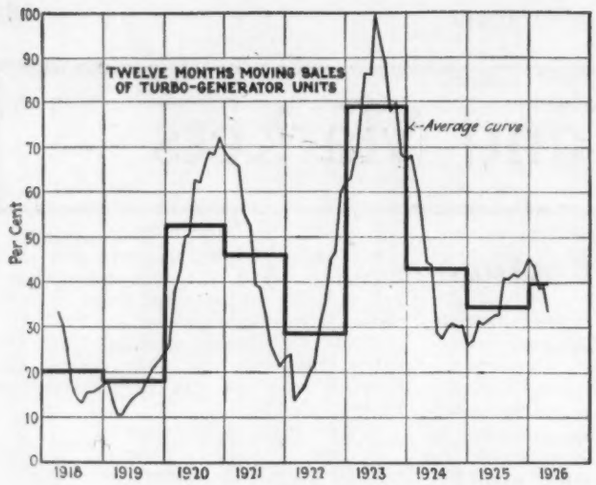
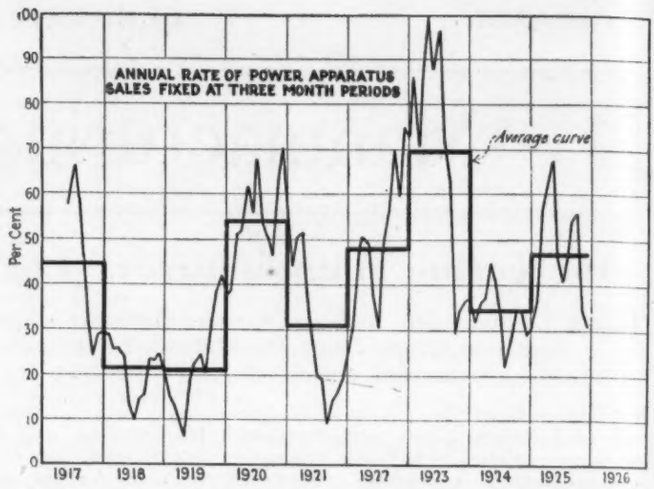
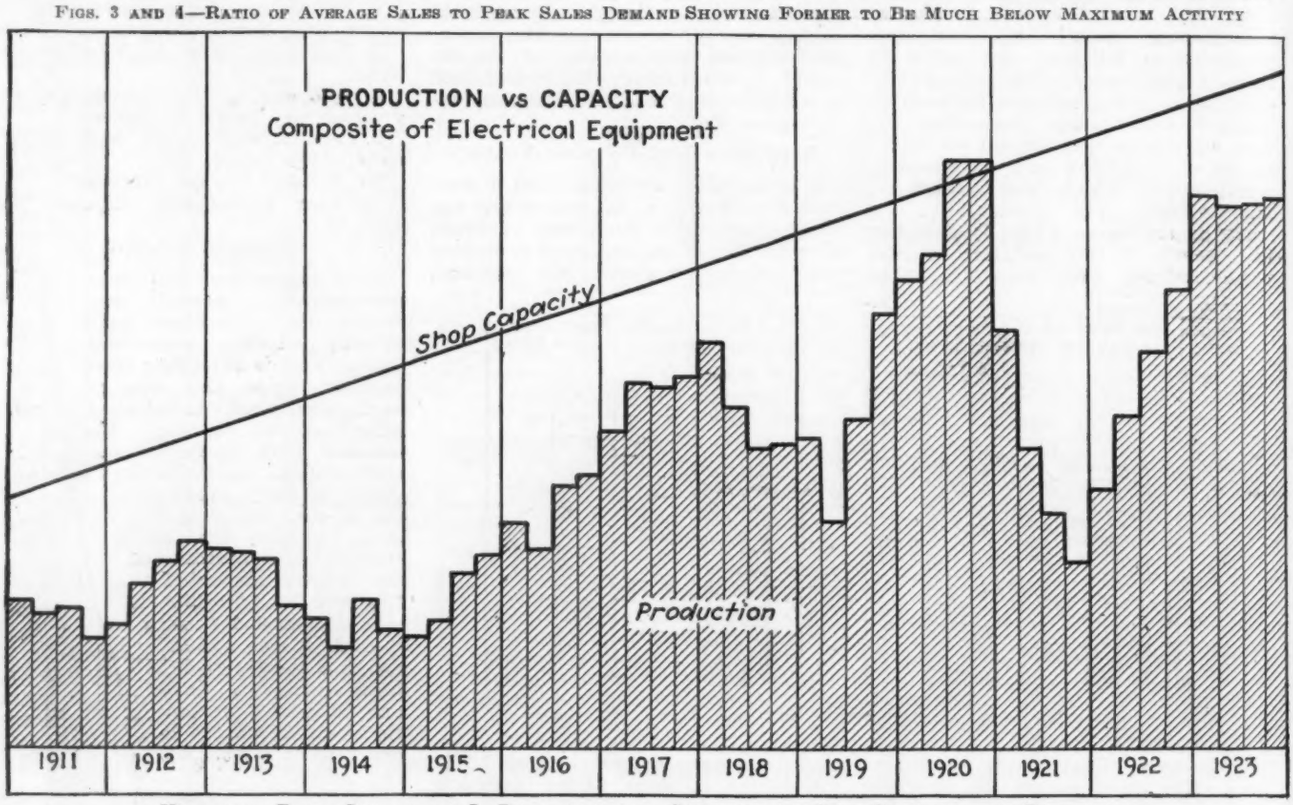


FIG. 2—TOTAL ENERGY GENERATED AND ITS DISTRIBUTION BETWEEN CLASSES OF SERVICE

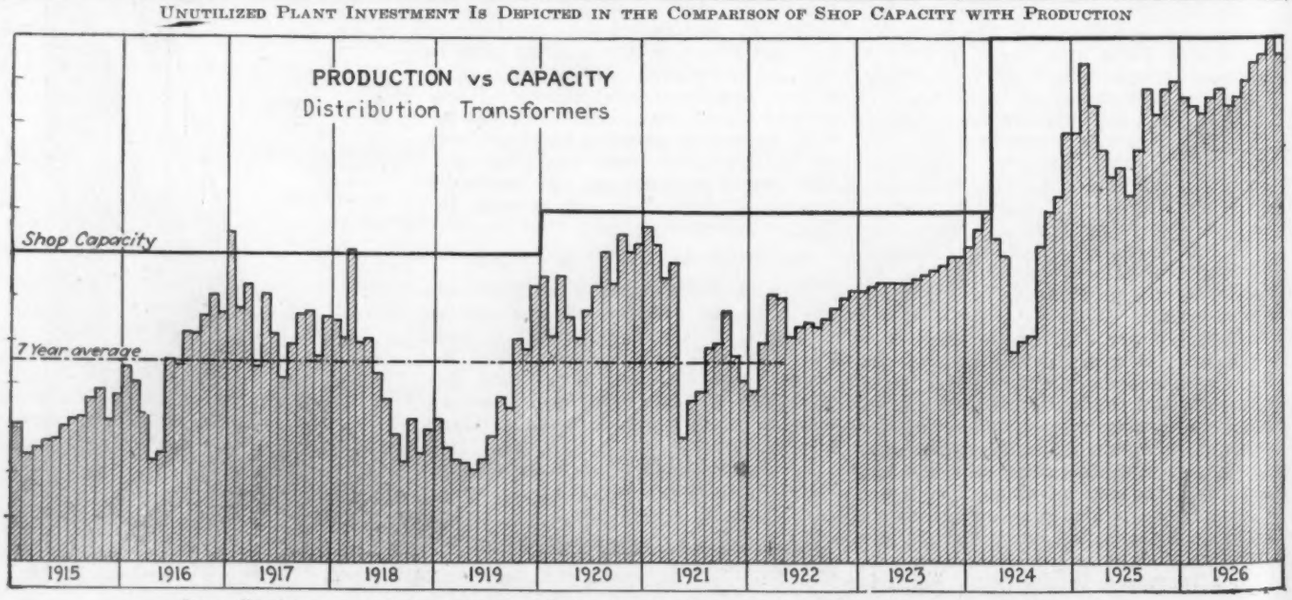




FIGS. 3 AND 4—RATIO OF AVERAGE SALES TO PEAK SALES DEMAND SHOWING FORMER TO BE MUCH BELOW MAXIMUM ACTIVITY



UNUTILIZED PLANT INVESTMENT IS DEPICTED IN THE COMPARISON OF SHOP CAPACITY WITH PRODUCTION



SHOP CAPACITY FOR MANUFACTURE OF DISTRIBUTION TRANSFORMERS COMPARED WITH PRODUCTION

in another year. The manufacturers' service and prices are no better than such a condition will permit.

For the past 25 years the per capita consumption of electrical energy has doubled each five years, and we know it will continue in the same way for years to come. This stability of public demand cannot be reconciled with the erratic fashion in which the orders for apparatus to supply that demand are given to the manufacturer.

MONEY MARKET RESPONSIBLE

The situation is a result of the money market, the nervous sensitive attitude, the "clear sky" policy of the men who have to provide the money. If these men realized the consequences of their timidity in waste of capital, in cost and quality of work and in labor unrest, it is probable they would change their methods. The cure is to be found in a system of longer term planning and in a national committee for keeping the central-station companies informed with respect to manufacturing conditions and manufacturers informed of the requirements that are ahead; in other words, a scientific application of the law of supply and demand.

STANDARDIZATION AFFECTS LOADING

Special orders are always a source of cost and delay to the manufacturer. About 75 per cent of the orders for power apparatus call for special features of design, which means a burden of several million dollars a year, but would be worth while if it always brought forth improvements. A good deal of this expense, however, would be saved if the industry would adopt more common standards.

For example, while there are about 2,000 power transformer units made per year, less than 5 per cent of that number can be manufactured for stock. The endless combination of primary and secondary voltages cannot be escaped, nor can the different types for different conditions; but when each order specifies its own special arrangement of taps, location of accessories, etc., it is impossible to manufacture transformers. Nearly 50 per cent of the industrial motor business is special, although there are 22,000 different standardized machines, and with steam turbines almost every new order seems to require a special creation.

ERADICATE LOSSES

The industry can no longer tolerate uneconomic wastes that were formerly disregarded. No one can predict what future invention will do, but the real duty is not performed if between the two partners of the industry, operator and manufacturer, any opportunity is omitted to eradicate the losses in their service to the public.

Fan Sales and Weather Forecasts

In a report covering long-range weather forecasts and their effect on fan sales, the General Electric Company states that in its experience the average temperature for the summer has no bearing on fan sales and that four or more consecutive days of extremely high temperature constitute "good fan weather." It would make no difference if the summer's average were even ten degrees below normal as it is the repetition of a few days of unbearable weather that drives people into stores for fans. If this series of hot days were preceded by a period of unseasonably cold weather, the high temperature would be even more noticeable and it is logical to conclude that fan sales would be increased by the contrast. The long-range weather forecasts predict that 1927 will have a summer of extremes in temperature, and just as the sudden changes from hot to cold may damage crops, so the sudden and violent change from cold to hot should favorably affect fan sales. The General Electric Company states that its fan manufacturing schedule for 1927 is the largest in its history.

Conditions of Award of Lincoln Arc-Welding Prizes

The American Society of Mechanical Engineers has just published a booklet outlining the conditions governing the award of the Lincoln arc-welding prizes for 1927. The preliminary rules appeared in the Jan. 22 issue of the ELECTRICAL WORLD. In addition to the complete rules, the booklet contains suggestions to entrants. The booklet calls attention to the fact that winners of these prizes will be selected on the basis of the amount of economic saving that the suggestion submitted shows either directly on the design submitted or in its possible wider application. The Lincoln Electric Company states that it stands ready to assist any one by suggestions or data upon request.

Business Conditions

ACTIVITY in the industry continues on a steady basis, with sales approximately in the same volume as for the corresponding period last year. Industrial plants are placing a large number of orders, and sales of small general-purpose motors are increasing. A considerable amount of apparatus has been quoted on by manufacturers, but so far orders have not materialized in proportion. A utility company in the Middle West has placed orders averaging $165,000 per day.

In New England power equipment sales are gaining and orders are mainly from industrial plants. Seven turbo-generator orders, ranging from 1,500-kw. to 3,000-kw., were placed with one manufacturer during February. Small-motor orders are increasing. Industrial plants are good buyers in the New York district, but sales to public utility companies were quiet. Trade is quiet in the Southeast, but business in general is considered satisfactory. Textile plants are active and have placed orders for equipment and electrical construction work. Medium-sized apparatus is in demand in the St. Louis district, and purchases are being made both by central-station and industrial companies. Increasing sales are noted in the Middle West and considerable construction work is under way. Sales are in good volume on the Pacific Coast, with many orders placed by power companies for line materials and supplies. Export orders were unusually varied and covered insulators, large motor equipment and wiring material.

Copper at High Price for Year—Lead Also Active and Higher

Copper reached a price of 13⅜ cents for Connecticut delivery, the highest since Dec. 29 last year, though sales in the last few days have not been heavy. There has been little difference in quotations by various sellers. Most of the business has gone to two sellers during the week and some of the others have sold so heavily recently that they are virtually out of the market except to regular customers. Lead sales have been active. On Wednesday the American Smelting & Refining Company advanced its price to 7.55 cents. A fair business has been done in zinc but it is not equal to that of last week. Domestic buying of tin has been dominated by dealers and speculators.

NEW YORK METAL MARKET PRICES

	Feb. 23, 1927 Cents per Pound	March 2, 1927 Cents per Pound
Copper electrolytic	13⅛	13⅜
Lead, Am. S. & R. price	7.40	7.55
Antimony	14¼	13¼
Nickel, ingot	35	35
Zinc spots	7.15-7.17½	7.15
Tin, Straits	69.875	69⅜
Aluminum, 99 per cent.	26	25

Base copper price March 2, 1927, 15½ cents.

Many Inquiries for Quotations Requested in Southeast

Trade is generally quiet in the Southeast, though here and there large single orders have been placed and a considerable number of inquiries for quotations are reported. Sizable orders were placed for regulator and control equipment for waterwheel generators, but no other large central-station orders are reported. A large number of small and moderate-sized orders are resulting in generally satisfactory business. New line construction resulted in orders from one company for poles, insulators, hardware and cross-arms amounting to approximately $8,000 and distribution and small power transformers totaling $5,500. Wire and cable are in steady demand, orders being placed by one company for $7,500 worth of underground conduit and $6,000 worth of cable.

Textile plants continue to be active, and some very satisfactory business is reported from this field. A contractor announces the closing of two electrification jobs, one in South Carolina and the other in Alabama, and orders for the wiring materials for these jobs have been placed, one amounting to $10,000 and the other to $15,000. There are also in hand two other sizable textile-

mill orders, one being for Alabama and calling for $40,000 worth of motors and the other from South Carolina, amounting to $35,000. Announcement is made of preliminary construction being started on a new half-million-dollar knitting mill in Alabama.

Industrial Plants Good Buyers in New York District

Public utility buying in the New York district continues quiet, no great amount of activity being apparent in any lines. A manufacturer of switching apparatus says that February sales were less than in any previous month for some time past. Transformers are in slightly better demand, although this is confined principally to small distribution units and no inquiries or sales of any great magnitude are reported. The demand for motors for industrial consumers is good, one manufacturer reporting sales this year exceeding the same period last year in total volume, but confined mainly to small-sized equipments. Machine-tool manufacturers appear to be taking the larger part of this production, although a considerable demand is shown for motors for pumps, refrigerating machines, fans, etc.

Power Equipment Sales Gaining in New England District

Increased demands for power equipment is noted in the New England district, particularly from industrial plants. Large-motor sales are relatively few but small-motor orders are increasing. During February a prominent manufacturer reported receiving seven turbo-generator orders in sizes ranging from 1,500 kw. to 3,000 kw. Switch and control equipment orders from industrial plants have continued and are active, and substation requirements amounting to over $100,000 were recently ordered.

Central-station supplies are in good demand. At the end of the first quarter more business is in sight this year than for the same period last year. Wire and line hardware sales are gathering strength, and a central-station company reports many lighting prospects in view. Lighting fixtures, small switches and hardware are in active demand, several inquiries for electric trucks were recently reported, and general jobbing conditions are satisfactory.

Sales in Good Volume on Pacific Coast

Power-company orders for line materials and supplies were in good volume on the Pacific Coast. Export orders were unusually varied and included 2,500 pin-type insulators valued at $5,000, two 350-hp. synchronous pumping motors, two 175-hp. pump motors and $8,500 worth of conduit and wiring material. Dealers' orders are good and the market is stable and growing stronger. Several good industrial orders included an 1,800-hp. pumping motor valued at $10,000, three carloads of poles for eastern Nevada and $2,000 worth of lead-covered submarine cable for a Nevada copper mine.

Few large sales were reported in the Puget Sound district, but the aggregate volume of business was satisfactory. The city of Tacoma has awarded a contract for approximately $50,000 for furnishing its annual requirement of distribution transformers. The demand for motors for pumping plants for irrigation districts in eastern Washington is increasing. New developments include a 1,500-kw. transformer installation in a new substation in Yakima, the Puget Sound Power & Light Company will make improvements to power lines near Entiat and construct 11 miles of new line from Toledo to Layton, a 100-ton pulp mill is planned for Astoria and a 150-ton paper mill for Port Angeles.

Increasing Sales Noted in the Middle West

The accelerated business, noticeable last week in the Middle West, continues. The purchases of one large utility company averaged over $165,000 per day. Considerable construction work is under way, with a large construction program in view. Milder weather conditions have permitted more line extensions with subsequent large demands for weatherproof wires and cables. Industrial activity compares very favorably with anticipated business and there is every reason to believe that this condition will continue for the balance of the quarter. The railroads are coming into the market with quite large requirements of varied items. Among the interesting orders placed this week were one for 450 distribution transformers in assorted sizes and Mazda lamps valued at $250,000. Jobbers' sales have kept pace with general business.

Medium-Sized Apparatus in Demand in St. Louis District

The demand for medium-sized apparatus continues in the St. Louis district, and there has been no decided change in business. Purchases are being made generally by central-station and industrial companies. One order was placed for a motor-generator set to cost approximately $15,000 and to be installed in a power station; another order reported was for a sand drier and a group of motors, from 1 hp. to 125 hp., amounting to $14,500, completely to electrify a glass-sand plant in Missouri, northwest of St. Louis, and another sale called for the complete outdoor switching equipment for three industrial substations for a power company south of St. Louis. Several medium-sized motors and transformers have been shipped from stock to the lumber district in Arkansas.

Activities of the Trade

Weston Instrument Corporation Earnings Show Increase

The Weston Electrical Instrument Corporation, Newark, N. J., in a preliminary report for the year ended Dec. 31, 1926, shows a net income of $666,553 after deducting expenses, depreciation and federal taxes. This compares with $646,930 for 1925. After the payment of dividends the company will have a surplus for 1926 of $486,504.

Co-operative Marketing Program for Electric Signs

The Society for Electrical Development, Inc., 522 Fifth Avenue, New York, has completed preparations for definitely launching the electrical advertising co-operative market development program designed to bring about a greater use of electric signs in all forms. The fundamental objectives of this program are to eliminate sales obstacles now existing and to educate commercial and industrial concerns to a better appreciation of the value of electrical advertising.

The activity is scheduled to progress along four lines: Interpreting the value of electrical advertising direct to prospective users; enlisting the co-operation of electric light and power companies to assist in this effort and to lend at all times their support; preparing a mutually desirable uniform model ordinance and endeavoring to have it adopted locally where the necessity is apparent, and promoting consistently co-operative undertaking and effort within the electric sign industry itself as an essential means effective to each of the above purposes. Those present at the meeting of the society were: O. D. Ziegler, H. H. Magdsick, E. B. Fox representing E. E. Potler, J. M. Gilchrist, L. L. Strauss, R. R. Wiley, W. T. Blackwell, W. W. Tower, and V. W. Sebastian representing H. C. Menefee. Kenneth A. McIntyre, R. Zindle and T. F. Chantler represented the society.

I. P. Morris and General Electric Get Alabama Power Orders

Contracts have been let by Alabama Power Company for generating equipment for the Upper Tallassee development, now under construction on the Tallapoosa River. The turbines were ordered from the I. P. Morris Corporation, Philadelphia, and the generators from the General Electric Company. The orders call for two reaction-type hydraulic turbines of 25,000 hp. each, for delivery in September, 1927, and February, 1928.

N.E.M.A. Creates Range and Water Heater Section

The National Electrical Manufacturers' Association, 30 East 42d Street, New York, has authorized the creation of a new section to be known as the range and water-heater section. It is the aim of the association to have all manufacturers of electric ranges in the United States become members of this section. Its purpose is the co-operative solution of manufacturers' merchandising problems, and to this end it will work with a similar committee of the National Electric Light Association. M. C. Morrow, assistant sales manager of the merchandising department of the Westinghouse Elec-

tric & Manufacturing Company, has been elected chairman of the new section, and A. L. Smith, sales manager of the electric range division of the Walker & Pratt Manufacturing Company, Boston, is secretary and treasurer. The section will function in the supply division.

National Refrigerating Offers New Absorption Refrigerator

A domestic refrigerating unit of the absorption type, known as the "Ice-O-Lator," is now being offered by the National Refrigerating Company, New Haven, Conn., after more than three years of operation in homes under regular observation. Operating on the absorption principle as it does, this unit has no moving parts of any kind. The basis of the application of the absorption system to the "Ice-O-Lator" is the use of a solid absorbent material which the manufacturer claims results in many advantages. The refrigerating unit is installed in the cabinet and the generating unit can be installed at a remote point. The refrigerator is available in both electric and gas-operated models. It is being made by the Winchester Repeating Arms Company, for the National company, and all required capacities are now coming through in a regular production schedule. The company also announces that a school for sales, installation and service men is being maintained at the plant.

Mutual Electric & Machine Changes Name

At a stockholders' meeting held in January the Mutual Electric & Machine Company, Detroit, voted to change the name of the company to the Bull Dog Electric Products Company so that the company and its products could be more closely associated in the mind of the public and the trade. Early in its career the company adopted the trade mark "Bull Dog," which through constant advertising has become widely known and familiar. The company manufactures safety switches, fusenters, switchboards and panelboards. The company states that its policies will be consistently carried out under the new name. The present officers of the company are: H. J. L. Frank, president; Leon H. Frank, vice-president and secretary, and F. M. Ferguson, treasurer.

French Battery & Carbon Company Under New Control

The French Battery & Carbon Company, Madison, Wis., which was organized in 1906 to engage in the manufacture of storage batteries and other products, has been purchased by the Insull interests of Chicago and Paine, Webber & Company of Boston, who will control the operations of the company in the future. E. J. B. Schubring of Madison, attorney for the Insull interests in Madison, has been chosen a vice-president of the company. Active management will be in the hands of W. W. Cargill, vice-president and general manager, who has been long identified with the organization. The company was organized in 1906 with a capital stock of $30,000, which has grown in the past ten years to $2,000,000.

Marshall E. Sampsell of Chicago is chairman of the board of directors, and J. B. Ramsey, formerly president of the French company; W. W. Cargill and William Balderston, all of Madison, are vice-presidents. Directors of the company are M. E. Sampsell, Chicago; Maurice F. LaCroix and John West, Boston; E. J. Furlong, Milwaukee; E. J. B. Schubring, J. B. Ramsey, William Balderston and W. W. Cargill, all of Madison, and A. Hall Berry of New York.

The Edison Electric Appliance Company, Inc., 5600 West Taylor Street, Chicago, announces price changes on some of its "Hotpoint" ranges. The company also announces new designs and a new finish on some ranges, as well as an addition to its line consisting of a "Kab" base for the RA97 range, a load-limiting switch for interconnecting a range and a water heater, and a thermostatic switch for a water heater.

The Hoover Company, North Canton, Ohio, has placed on the market a new and lower-priced suction sweeper, known as the model 543. The Hoover line, accordingly, now consists of models 700 and 543, which are designed for use in the average home, and model 961, for use in large homes, clubs, hotels, stores and other large places.

B. F. Sturtevant & Company, Hyde Park, Mass., manufacturer of heating and ventilating fans, power plant apparatus and motors, announces that about April 1 its New York office will move from 52 Vanderbilt Avenue to the Graybar Building, Lexington Avenue between Forty-third and Forty-fourth Streets.

The General Electric Company announces that 27 employees on March 4 were awarded Charles A. Coffin Foundation certificates of merit for their outstanding services toward the increase of the company's efficiency or progress in the electrical art during 1926. With each certificate went four shares of General Electric common stock. One-third of the 27 awards were to workmen, two to foremen, eight to engineers, five to commercial men and three to administrative employees.

The Silvray Company, Inc., 55 West Sixteenth Street, New York, manufacturer of the Silvray system of indirect illumination, has been purchased, together with its patents and other assets, by M. B. Beck, who is also the new president. The plant of the new company has been established at the above address, where the manufacture of Silvray bulbs and lighting units will be continued. Associated with Mr. Beck, as director of sales, is J. M. Gilbert, formerly with the McGraw-Hill publications.

The Electrical Engineers Equipment Company, Melrose Park, Ill., manufacturer of high-tension switching and protective equipment, has published a booklet entitled "Eighteen Years of Progress," in which it describes the history and development of the company. A detailed description of the company's new plant is included in the booklet. The plant, which has only recently been completed, is on grounds comprising approximately 17 acres. The company issues an invitation to all its customers and friends to visit the new plant when in Chicago.

The Bussmann Manufacturing Company, St. Louis, manufacturer of "Buss" fuses and lights, announces the purchase of a new four-story building located at University and Jefferson Avenues. A. B. Bussmann, president, states that this new building will more than double its present floor space. The entire Twenty-third Street factory and office has been moved into the new location.

Edwards & Company, Inc., 140th and Exterior Streets, New York City, manufacturer of annunciators, bells and other signaling devices, announces that it has opened its own branch office at 176 Federal Street, Boston, under the management of J. T. Gorman. The company also has opened its own office at 626 Land Title Building, Philadelphia, under the management of R. H. Andrews.

The Burke Electric Company, Erie, Pa., manufacturer of direct-current and alternating-current machinery, announces the removal of its Pittsburgh sales and service office to 2124 Farmers' Bank Building. W. S. Wallace, who has been Pittsburgh manager of the company for several years, will continue in charge of this office.

The Servel Corporation, 51 East Forty-second Street, New York City, has established a complete servicing plant at 1233 South Hope Street, Los Angeles. While this new plant is intended primarily to handle the wholesale business of southern California and Arizona, some of the Metropolitan retail business will also be handled at the new location.

The Union Electric Company, Liberty Avenue, Pittsburgh, has awarded a contract for a 45-ft. x 225-ft. extension to its six-story storage and distributing plant.

The Western Electric Company has secured a permit for the construction of three multi-story additions to its plant on Central Avenue, Kearney, N. J., estimated to cost about $1,350,000, with machinery.

J. P. Clements, 15 Moore Street, New York City, is now offering a line of foreign made mercury switches in capacities from 2 amp. to 30 amp.

The National Refrigerating Company, New Haven, Conn., manufacturer of the "Ice-O-Lator," an absorption-type electric and gas-operated refrigerator, announces that John C. Douglas has been appointed Pacific Coast representative.

The G. & W. Electric Specialty Company, 7780 Dante Avenue, Chicago, has awarded a contract to the Austin Company for a one-story addition to its factory, 75 ft. x 320 ft.

The Busch-Sulzer Brothers Diesel Engine Company has received an order from Sanderson & Porter for a 3,750-b.hp. Busch-Sulzer Diesel engine. This engine will be installed in the Tucson (Ariz.) plant of the Federal Light & Traction Company, and will be direct-connected to a 2,600-kw. flywheel-type generator. The unit will have six cyl-

inders, is of 30-in. bore and 42-in. stroke and will run at 124 r.p.m. The engine will be similar in appearance to those furnished by the company to the United States Shipping Board.

The Warren Electric Heating Appliance Company, Warren, Pa., recently organized by Emil Stranszky and associates, has taken over property on Lexington Avenue and will establish a new plant for the manufacture of electric heating equipment. Mr. Stranszky, who will head the new company, was formerly chief engineer for the Automatic Electric Heater Company, which removed its factory from Warren to Pottstown, Pa., several months ago.

The Reynolds Electric Company, 2650 West Congress Street, Chicago, manufacturer of fractional-horsepower motors and motor-driven appliances, announces that it has purchased and has taken over the Maxim Equipment Company, Chicago, manufacturer of the Maxim and "Sim-Peel-O" vegetable peeler, including all manufacturing and patent rights, patterns, tools, dies etc., and is now in a position to fill orders for complete machines or repair parts. The machine will be sold under the trade name of the Reynolds company and will be called the "Reco" vegetable peeler. Charles F. Smith, former proprietor of the Maxim Equipment Compnay, has become affiliated with the Reynolds organization.

The Century Electric Company, St. Louis, has taken out a permit for the construction of a one-story addition to its plant on Pine Street, 105 ft. x 125 ft.

The James R. Kearney Corporation, 4224 Clayton Avenue, St. Louis, manufacturer of overhead and underground utility equipment, announces that the J. E. Sumpter Company, Securities Building, Minneapolis, Minn., formerly representative of the W. N. Matthews Corporation of St. Louis, has recently joined its sales organization. He will be in charge of sales in Minnesota, North and South Dakota, and parts of Wisconsin, Michigan and Montana.

New Equipment Available

Automatic Speed Regulator for Impulse Turbines

The Pitman automatic deflector regulator for impulse turbines ranging from 0.05 hp. to where the head of water and horsepower is considerable has been developed by Percy Pitman, 25 Victoria Street, Westminster, London, S.W. 1. The regulator gives a constant speed under all conditions of load. Any standard centrifugal or oil-pressure governor can be used to actuate the deflector, which is arranged directly in front of the nozzle and embraces the jet. There is a slight constriction of the passage through it toward the outlet end so that instant action will take place on all load changes. Where economy of water is of great importance, the needle reducing the flow of water can be interconnected with the deflector and by this means the whole or any portion of the load can be instantly cut off without increase of pressure in the pipe line.

High-Strength Wire

A high-conductivity, high-strength wire suitable for long spans and known as Anaconda "Hitenso BB" has been placed on the market by the American Brass Company, 25 Broadway, New York. The manufacturer states that this new wire can be spliced or tapped as easily as copper, is the most economical conductor for rural lines and long spans, and by its use extensions can be made and new customers connected to existing lines with a minimum of labor, material and time. In service "Hitenso BB" is said to be highly resistant to the effects of arcs, lightning, insulator flashover and abrasion which damage softer and less rugged conductors. This wire meets the physical requirements of the American Society for Testing Materials and exceeds the specified conductivity by 15 per cent. The company also manufactures other grades, known as "Hitenso A" and "Hitenso C," a medium-strength bronze and a high-strength bronze respectively.

Dust-Proof, High-Voltage, Automatic Compensator

An automatic compensator of dust-proof design for high-voltage service and recommended for use where dust is excessive, as in coal-crushing plants, flour mills, etc., has been placed on the market by the General Electric Company. This device has a maximum rating of 65 amp. at 2,200 volts. The side and top covers are securely bolted to angle-iron straps. The back cover is removable, but when in place is held there by spring clamps. This back cover gives ready access to the current transformers, auto-transformers, wiring and contactor-operating mechanism. The front cover is securely clamped to the base with a flange and gasket around the edge. The compensator is arranged for conduit wiring. The conduits enter at the back through a bushing plate. The device bears the designation "CR-7051-Y-1."

Expulsion-Type Porcelain Plug Cut-out

An expulsion-type porcelain-plug cut-out for 2,300-volt and 4,000-volt lines, where positive fuse protection on all amperages up to and including 30 amp. is required, has been placed on the market by the James R. Kearney Corporation, 4224 Clayton Avenue, St. Louis. The features claimed by the manufacturer for this new type of plug cut-out are these: An added petticoat is provided on the housing for protection against dirt and water; plugs are interchangeable with the standard plug cut-outs; the porcelain housing and porcelain plug are glazed all over, inside and outside; an extension of the expulsion plug allows the gases to be dissipated outside the housing, and the cut-out can be re-fused with standard round lead fuse wire. The contacts are made of heavy phosphor spring bronze, and should the fuse blow there is no chance of the plug being blown out of the contacts as no pressure is created within the housing.

Steel Switchboards

A simple construction of steel switchboard panel for which the manufacturer claims several outstanding advantages can now be furnished by the General Electric Company. The construction is such that the new board partakes of the conventional switchboard features to an extent that makes it possible to install the new and old types together, temporarily or permanently. Combinations of steel and slate or ebony asbestos panels can be made with the use of the new design. Pipe supports are retained on the steel panels, and each panel can be shipped completely wired without unusual care and bracing in packing. In erecting the board, the framework is set up first, and the individual panels are then installed. The panel wiring is grouped in trough-shaped recesses at the sides of each panel.

When installing slate or ebony asbestos panels adjacent to the new steel design, the so-called angle-pipe construction of support is used; that is, the former are mounted on light angles placed ¼ in. inside the edges of the panels. These angles serve to support the several sections of the panels and the wiring during shipment. The dimensions of the steel panels with their supporting edges are the same as those of corresponding slate or ebony asbestos panels with supporting angles. The rounded edge of the steel panel matches the rounded edge on the next steel panel, or the ¼-in. or ⅜-in. bevel on the adjacent old panel. The new panels are made in standard widths of 16, 20, 24, 28 and 32 in., with a standard height of 90 in.

Parkway Cable

A new parkway cable, known as "Loxsteel" cable, is being made by the Hazard Manufacturing Company, Wilkes-Barre, Pa., and is armored with a single-shaped steel strip. The steel strip is wrapped on the cable spirally and so formed as to interlock the convolutions, giving a continuous protective steel sheath without any opening. The strength of this covering is said by the company to compare favorably with that of the regular double flat-steel covering. This cable is offered for use where a lighter type of parkway cable is desirable without sacrificing to any considerable extent the inherent qualities of the standard double-steel cable.

Mica Undercutter.—An electrically operated portable mica undercutter is being manufactured by the Hullhorst Micro Tool Company, Toledo, Ohio. The machine uses a small cutter only ½ in. in diameter. The tool is driven by a Westinghouse motor and can be operated from any ordinary light circuit of 110 volts by means of the attachment cord and plug.

New Trade Literature

AIR FILTERS.—The midwest Air Filters, Inc., Bradford, Pa., is distributing two booklets, one containing detail sheets of Midwest air filters and the other describing the use of the Midwest air filters for compressors and methods of installing the Midwest type "B" air filters.

BALL BEARINGS.—A well illustrated bookl t issued by the New Departure Manufacturing Company, Bristol, Conn., entitled "The Advantages of Ball Bearings in Electric Motors," describes the use of ball bearings in electric motors. Included in the booklet is a complete description of the various ways of mounting ball bearings in general purpose motors as well as a discussion of the advantages and disadvantages of the different methods. Several tables give the dimensions of the various types of ball bearings.

CONDUIT FITTINGS. — The Crouse-Hinds Company, Syracuse, N. Y., has issued bulletin No. 2,097, which supersedes bulletins Nos. 2,085 and 2,089, describing its various types of "groundulets." Line drawings showing suggested types of construction for standardized grounding regulations are included.

OIL CIRCUIT BREAKERS. — Leaflet L-3969-B issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., describes and illustrates its types E-8, E-9, E-16 and E-17 oil circuit breakers, manually and electrically operated, automatic and non-automatic, indoor service, single-throw.

SOLDERING POT.—A folder issued by the Electro Engineering Company, Inc., 11,712 Atlantic Avenue, Richmond Hill, N. Y., covers its type B "Electro Melter," an electrically operated soldering pot designed to meet the needs of central-station and substation, construction and repair crews.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An agency is desired in Bombay, India (No. 24,225), for electrical cooking and heating appliances and electric novelties, electrical goods, wires, cables, switches, fuses, brackets and accessories.

Purchase is desired in Mexico City, Mexico (No. 24,222), of hand driers for lavatories.

An agency is desired in Karlsruhe, Germany (No. 24,227), for electrical household appliances.

Purchase and agency are desired in Frankfort, Germany (No. 24,214), for electric generators.

An agency is desired in Melbourne, Australia (No. 24,226), for house and farm lighting systems.

Purchase is desired in Vancouver, B. C. (No. 24,266), of electrical meat slicers and coffee grinders.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BURLINGTON, VT.—Plans are being considered by the Burlington Light & Power Company for the construction of a new hydro-electric plant to replace the old hydro-electric plant at Winooski. The new equipment will include two generating units of 2,000-hp. each under head of 32 ft.

BOSTON, MASS.—The New England Telephone & Telegraph Company, Boston, has appropriated $54,250 for aerial and underground cables in Richmond central district; $14,850 for various streets in Charlestown; $54,250 for underground and aerial cables and conduits in Lexington, and $26,427 for additional switchboard equipment in Congress central exchange in Boston.

LYNN, MASS.—The erection of a fire station for fire-alarm headquarters, to cost about $150,000 is under consideration.

THOMASTON, CONN. — The Hartford (Conn.) Electric Light Company has arranged for an easement in the Naugatuck State Forest in this section for a proposed transmission line.

Middle Atlantic States

MIDDLETOWN, N. Y.—Bids will be received by the Department of Mental Hygiene, Capitol, Albany, until March 23, for a refrigerating plant at the Middletown State Hospital.

NEW YORK, N. Y.—Bids will be received by the Superintendent of Standards and Purchase, Executive Department, Room 106, Capitol, Albany, until March 10, for a refrigeration unit for the New York House of Refuge, Randall's Island, New York City.

NEW YORK, N. Y.—A permit has been granted the New York Edison Company for a substation at 40 Thompson Street, to cost about $350,000. William Whitehill, 709 Sixth Avenue, is architect.

PATCHOGUE, N. Y.—Steps have been taken by the Main Street Merchants to secure an extension of the street lighting system both east and west along Main Street to the village limits.

PHILADELPHIA, PA.—The Philadelphia Electric Company plans to build a substation at Olney and Wister Streets. John T. Windrum, Commonwealth Building, is architect.

FARMVILLE, VA.—The Virginia Public Service Corporation, Charlottesville, which has acquired the municipal electric plant, plans to extend its transmission line to Farmville.

ROSSLYN, VA.—The Home Ice Company plans to build an ice-manufacturing and refrigerating plant, to cost about $130,000.

WASHINGTON, D. C.—Plans have been approved by the District Commissioners for extensions and improvements in the street-lighting system.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, until March 8, for 58,500 ft. bell wire, (Schedule 6587), and refrigerating equipment (Schedule 6831) for Hampton Roads yard; and, for two X-ray machines, interrupterless-type, for the Brooklyn Navy Yard (Schedule 6833).

WASHINGTON, D. C.—Bids will be received by the General Purchasing Officer, Panama Canal, Washington, until March 16, for 5,000 ft. rubber insulated wire, 3,000 ft. rigid conduit wire, two 15-kva. transformers, 1,500 weatherproof sockets, 3-pole switches, resistance units, bell-ringing transformers, 7,800 dry cells, audio transformers, etc. (Circular 1788).

North Central States

OWOSSO, MICH. — Extensions and improvements, to cost about $200,000, are contemplated by the Consumers Power Company, Jackson, in its system at Owosso, Corunna, Durand, Perry, St. Charles and vicinity.

PONTIAC, MICH. — The Consumers Power Company, Jackson, plans triple the capacity of its substation on Rundell Street, and also to extend its transmission lines from Pontiac to Framington, Keego Harbor and vicinity.

CLARKSON, KY.—The Kentucky Utilities Company, Louisville, is planning to install a street-lighting system in Clarkson.

CYNTHIANA, KY. — Extensions and improvements to the local street-lighting system, to cost about $7,000, are contemplated by the Kentucky Utilities Company, Louisville.

WICKLIFFE, KY.—The Kentucky Utilities Company, Louisville, plans to build a new distribution system and other improvements here, to cost about $10,000.

MARINETTE, WIS.—The City Council has contracted with the Menominee & Marinette Light & Traction Company for the installation of an ornamental lighting system on portions of Hall Avenue, Main and Hosmer Streets, requiring about 120 concrete standards mounted with single lamps.

ST. PAUL, MINN.—Preliminary plans for the proposed ornamental lighting systems on portion of Edmund Street, West Ninth Street, Thomas Street, and on Franklin Street, have been approved by the City Council. G. W. Shepard is city engineer.

IOWA CITY, IOWA.—Plans are being considered by the City Council for the installation of a new ornamental lighting system.

KANSAS CITY, MO.—Plans are being considered by the Kansas City Power & Light Company for hydro-electric development in Southern Missouri, to cost about $20,000,000.

ST. LOUIS, MO.—The Krey Packing Company, 2100 Bremen Avenue, contemplates the installation of a cold storage and refrigeration plant in its proposed plant at 6600 North Broadway, to cost about $750,000.

BISMARCK, N. D.—Application has been filed by the Hughes Electric Company with the Railroad Commission for permission to erect a transmission line from Bismarck to Tappen.

BISMARCK, N. D.—A bill has been submitted to the State Legislature asking an appropriation for the erection of a transmission line from the electric power plant at the penitentiary to furnish service to the capitol and other state buildings.

VELVA, N. D.—Plans of the Truax-Traer Coal Company for developing lignite fields, at a cost of about $1,000,000, include a power plant on the Mouse River to furnish power for mining operations.

COLUMBUS, NEB.—The Northwestern Public Service Company, Huron, S. D., has applied to the Public Service Commission for permission to erect a transmission line to Richland. It is proposed to serve residences along the line as well as in Richland.

NELIGH, NEB. — The Western States Public Utilities Company, Lincoln, has submitted a proposal to the City Council offering to install an electric generating plant and distribution system and furnish electric service in the city, the entire system to be eventually turned over to the city. An alternate proposal is for the company to build the generating plant and the city the distribution system, the latter to purchase energy from the company for distribution in the city.

WALTHILL, NEB.—Permission has been granted the Central States Electrical Company, Omaha, to issue $50,000 in capital stock to finance the purchase the electric plants and distributing systems in Homer and Winnebago and the generating plant at Walthill, three adjoining towns. Later the company will enlarge the electric plant at Walthill and supply electricity in Homer and Winnebago over a transmission line.

OLIVETT, KAN.—The City Council is considering the installation of an electric light and power system.

Southern States

MARSHALL, N. C.—The Carolina Power & Light Company, Raleigh, plans to build a power plant in Marshall, and also to extend its high-tension transmission line from Spruce Pine to Marshall, at a cost of about $300,000.

COLUMBIA, S. C.—The construction of a large hydro-electric plant on the Saluda River, about 10 miles from Columbia, has been announced by the General Gas & Electric Company, 50 Pine Street, New York City. The plans provide for the construction of a dam more than 8,000 ft. long, 188 ft. high, creating a lake over 30 miles long, with an average width the entire length of 3 miles. The eventual capacity of the plant will be 200,000 hp. The initial expenditure is placed at $20,000,000. Murray & Flood, Grand Central Terminal, New York City, are supervising engineers.

AVON PARK, FLA.—The Florida Public Service Company, Orlando, has acquired a site on Lake Lotela in Avon Park for a new steam electric generating plant, which will have an initial capacity of 12,500 kw. The plant will serve the Scenic Highland branch, which will extend from Seville to Lake Sterns, and will be linked with the Benson Springs plant by 33,000 and 66,000-volt lines.

BIRMINGHAM, ALA.—Plans have been announced by the Alabama Power Company for the erection of a new 110,000-volt transmission line from Martin Dam to the North Auburn substation on the west and from Martin Dam to Lock 18 on the East. The new circuit, which will be 48 miles long, will be of creosoted wood-pole construction, and will have a capacity of 50,000 hp. Extensive additions will be made at the Martin Dam, North Auburn and Lock 18 substations.

STUTTGART, ARK. — A permit has ben granted C. C. Cox and Robert Curtis, to build an electric light plant for local service. A transmission line is contemplated.

WASHINGTON, LA.—The Gulf Public Service Company, Jacksonville, Tex., which has acquired the municipal electric plant, plans to erect a transmission line for local service.

WEWOKA, OKLA. — Preliminary plans have been prepared for the installation of a 400-hp. Diesel engine and generator at the city pumping station, to cost about $35,000.

AMARILLO, TEX.—The board of directors of the Southwestern Public Service Company have approved an expenditure of $2,000,000 for improvements and extensions in its power transmission system. The company is considering the installation of a second unit at its plant before the end of the year.

BROWNSVILLE, TEX. — Steps have been taken by the Brownsville Chamber of Commerce for the installation of an improved lighting system on the highway from Brownsville to La Feria, a distance of about 40 miles.

CHILDRESS, TEX. — Preliminary surveys are being made by the Texas Power & Light Company, Dallas, for a proposed dam and central power plant near Childress. It is proposed to build a dam across Mountain Creek to create a reservoir to provide water for a power plant. The company plans to extend its high-tension transmission lines to a number of towns in this part of the state.

SAN ANGELO, TEX.—Plans are under way by the West Texas Utilities Company, Abilene, for extensions to its plant on Lake Concho, near San Angelo, to cost about $300.000. Sargent & Lundy, 1412 Edison Building, Chicago, are engineers.

Pacific and Mountain States

SEATTLE, WASH. — The Puget Sound Power & Light Company plans to build a substation at 616 West Forty-fifth Street, to cost about $50,000 . W. D. Shannon is engineer for the company.

SOUTH BEND, WASH.—Permission has been granted the Peoples West Coast Hydro-electric Corporation to construct a hydro-electric plant on the Nasel River, near South Bend, estimated to cost about $200,000, with transmission system.

TACOMA, WASH. — The City Council has authorized the installation of an ornamental lighting system on portions of M Street, on South Tacoma Way, and Union Avenue.

OROVILLE, CAL. — A special election will be held on March 14 to vote on the proposal to issue $150,000 in bonds for the purchase of the local electric system of the Pacific Gas & Electric Company to be owned and operated by municipality. Extensions and improvements are planned.

RIO BRAVO, CAL.—The San Joaquin Light & Power Company, Fresno, plans to erect a 110,000-volt steel-tower transmission line from Bakersfield to Rio Bravo, about 16 miles long.

VAN NUYS, CAL.—The Glendale (Cal.) Creamery Company plans to build a pasteurizing and refrigerating plant here, to cost about $50,000.

WOODLAND, CAL.—The Pacific Gas & Electric Company, San Francisco, appropriated about $20,000, for extensions in its local substation.

TOOELE, UTAH.—A franchise has been granted the Utah Power & Light Company by the City Council permitting the company to modernize the local electric distribution system, including the installation of a series street-lighting system.

TUCSON, ARIZ.—Plans are under consideration by the Tucson Gas, Electric Light & Power Company for the installation of a Diesel engine generating unit, etc., to double the present capacity of its plant.

Canada

TORONTO, ONT.—Plans are being considered by the Toronto Hydro-Electric System for the construction of a substation, to cost about $150.000, on Laxton Avenue.

TORONTO, ONT.—Tenders will soon be asked by the Hydro-Electric Power Commission of Ontario, Toronto, for steel towers for its proposed 200-mile, 220-kv., single-circuit transmission line from Toronto to the Ottawa River. Frederick A. Gaby is chief engineer.

Electrical Patents

Announced by U. S. Patent Office

(Issued Feb. 15, 1927)

16,551 (reissue). DASHPOT-CONTROLLED SWITCH; G. O. Wilms, Milwaukee, Wis. App. filed Feb. 20, 1920. Means for regulating or controlling the time factor in the operation of the switch.

1,617,344. ELECTRIC CIGAR LIGHTER; J. R. O'Neil, Chicago, Ill. App. filed Feb. 8, 1926.

1,617,354. ELECTRIC WELDING TOOL; D. A. Reynolds, Yonkers, N. Y. App. filed Feb. 19, 1925. Welding pliers for small work.

1,617,359. HEAT-TREATING FURNACE; S. Westberg, Pittsburgh, Pa. App. filed March 18, 1925. A furnace chamber having electric heating means and which is separated from an auxiliary chamber by a common wall member, the combination of the two chambers forming a unitary structure. The furnace chamber is subjected to the operation of a vacuum pump to remove the air therefrom and produce a partial or a substantially complete vacuum therein. The auxiliary chamber is subjected to the operation of a pressure pump that forces either an inert or a reducing gas into the chamber. The auxiliary chamber seals the furnace chamber, thereby providing a structure that may be used for treating metallic articles with heat without oxidizing effect.

1,617,360. MAGNETIC TEMPERATURE-CONTROL SYSTEM; J. C. Woodson, East Pittsburgh, Pa. App. filed April 24, 1925. For electric furnaces.

1,617,361. FURNACE RESISTOR MOUNTING; J. C. Woodson, East Pittsburgh, Pa. App. filed Nov. 28, 1923.

1,617,363. SWITCH MECHANISM; H. K. Ansingh, Toronto, Ontario, Canada. App. filed Feb. 20, 1923. Circuit breaker of the truck-panel type.

1,617,373. CONDUCTOR-WIRE TERMINAL; G. A. Childs, Arlington, Mass. App. filed June 10, 1924. May be used with many sizes of wire.

1,617,377. RELAY; L. N. Crichton, Edgewood Park, Pa. App. filed July 30, 1920. For protecting electrical distributing systems against grounds.

1,617,390. ARC-EXTINGUISHING DEVICE; E. A. Hester, Brooklyn, N. Y. App. filed June 17, 1920. Apparatus for extinguishing arcs that occur in distribution systems.

1,617,394. ELECTRIC DRIVING INSTALLATION; N. Japolsky and M. Kostenko, London, England. App. filed Oct. 16, 1922. A form of drive for ships' propellers and power rollers. An alternating-current motor is used, and this is supplied with its full driving current by a generator, which is adapted to be driven at constant speed and to provide the whole power required, while permitting its frequency and voltage to be varied. For this purpose the generator is constituted of an alternating-current commutator machine in which the stator and rotor main power currents are arranged, one with a continuous winding and the other with a discontinuous winding, the various power phases of the alternating-current motor being connected across the gaps of this discontinuous winding in order to obtain neutralization of the stator and rotor main power currents under the best conditions, and the magnetic field of said generator being wholly provided by an exciting current from a separate exciting machine, which is provided with means whereby its frequency may be controlled.

1,617,396. HEAT-TREATING FURNACE; A. D. Keene, Pittsburgh, Pa. App. filed Oct. 15, 1923. High-temperature electric furnace.

1,617,406. METER-OPERATED CIRCUIT CLOSER; W. L. Marden, New York, N. Y. App. filed Nov. 21, 1924. Time-element operation where the flow of liquids is involved.

1,617,474. ELECTRICAL CONNECTER; E. Alschuler, New York, N. Y. App. filed Feb. 10, 1923. Two-way connecter attached to a through wire.

1,617,489. ELECTRICALLY HEATED DEVICE AND METHOD OF MANUFACTURE THEREOF; E. N. Lightfoot, New York, N. Y. Comprising an element to be heated, a heating element and a cast-metal shell containing the heating element and surrounding the element to be heated, the shell being contracted on the latter element to subject the same permanently to a compression force.

1,617,515. ARC SHIELD; C. T. Evans, Milwaukee, Wis. App. filed April 20, 1921. For magnetic blowout devices.

1,617,521. CANOPY SWITCH; H. Hubbell, Bridgeport, Conn. App. filed Oct. 29, 1924.

1,617,558. ELECTRIC TOASTER; F. E. Wolcott, West Hartford, Conn. App. filed Nov. 16, 1925. Oven type.

1,617,594. RELAY; C. O. Harrington, Chicago, Ill. App. filed June 2, 1921. In which, at pick-up current, a suitable pressure between the make-and-break contacts will be automatically provided throughout the normal and substantially large range of adjustment of the air gap in the magnetic circuit.

1,617,595. LANTERN; C. O. Harrington, Chicago, Ill. App. filed Nov. 21, 1921. Signal lanterns, such as are used on the railway right-of-way and at highway crossings.

1,617,625. TRUNKING-CONDUIT CONSTRUCTION; J. M. FitzGerald, River Forest, Ill. App. filed Aug. 5, 1920.

1,617,633, 1,617,634, 1,617,635, 1,617,636, 1,617,637. ELECTRIC ARC LAMP; J. A. Heany, New York, N. Y. Apps. filed July 15, 1916, and June 11, 1917. Involving a container or envelope, preferably adapted for connection in the ordinary incandescent lamp socket, within which are mounted terminals or electrodes, one or both of which comprises a highly refractory compound, such as oxide of thorium, oxide of zirconium or the like; which possesses, in high degree, the quality of selective radiation, when highly heated, the heating being effected either by means of a refractory metal, such as tungsten, associated with the refractory compound, and which is included in the electric circuit, or by means of a subsidiary heating coil which is adapted to be cut out of circuit when the arc has been established, the arcing electrode being associated with a ballast or regulating resistance which in itself becomes incandescent under the influence of the operating current, the envelope preferably containing an atmosphere of gas which is inert with respect to the incandescing ballast wire, as well as to the metal constituent of the electrode, but which is neverthless capable of becoming ionized to maintain a relatively long arc between the electrodes when the latter have been initially heated to a degree sufficient to render them capable of maintaining an arc.

1,617,684. ELECTRIC GAS-FILLED DISCHARGE DEVICE; G. Holst, E. Oosterhuis, and J. Bruijnes, Eindhoven, Netherlands. App. filed Feb. 8, 1922. In which a luminous glow discharge is made use of for illumination purposes.

1,617,691. SYSTEM OF LIGHTNING PROTECTION; E. C. van Diest, and F. Gilpin, Colorado Springs, Col. App. filed Aug. 6, 1921. For the protection of buildings, tanks and other structures.

1,617,720. TRAFFIC GUIDE MARKER; W. Morris and C. Wyrostok, Trenton, N. J. App. filed May 20, 1925.

1,617,770. ELECTRODE-OPERATING MEANS FOR WELDING MACHINES; E. Schroder, Berlin, Germany. App. filed Sept. 2, 1921.

1,617,788. DEVICE FOR PREVENTING ELECTRICAL IGNITION OF STORED INFLAMMABLE FLUIDS; L. A. Baldwin, University City, Mo. App. filed May 25, 1925.

1,617,802. NON-SYNCHRONOUS MOTOR; V. A. Fynn, St. Louis, Mo. App. filed April 22, 1926. Methods and means for starting and operating polyphase nonsynchronous induction motors. The method of operating a non-synchronous induction motor, comprising the passing of phase-displaced alternating currents through windings to produce a flux revolving synchronously with respect to these windings, causing the revolving flux to generate starting torque-producing currents in a circuit or circuits having a certain inductive relation to the revolving-flux-producing windings, and thereafter producing part of the revolving flux by passing phase-displaced alternating currents through windings which are in closer inductive relation to the circuit or circuits in which the torque-producing currents are generated.

1,617,810. DOUBLE T. CAP; H. Hubbell, Bridgeport, Conn. App. filed July 27, 1921.

1,617,836. RAIL BOND; W. F. Daugherty, Cleveland, Ohio. App. filed June 4, 1926. Adapted to be welded to the base of a rail.

1,617,856. ARMATURE MOUNTING; B. F. Lollis, Berwyn, Ill. App. filed Feb. 14, 1924. Used in connection with relay devices such as are used in electric signals.

1,617,866. CORD PROTECTING AND SUPPORTING DEVICE; M. R. Rodriques, Brooklyn, N. Y. App. filed Jan. 4, 1924.

Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business

Europe's Homes Await Electrification

THAT Europe is still comparatively a virgin field for the domestic use of electricity is apparent from a table recently published by the Department of Commerce showing the estimated number of wired homes in various countries in that continent. These estimates show that the only country approaching saturation in that respect is Switzerland. A comparison of the number of houses — 415,000 — with the number of domestic customers—400,000—indicates that 96.5 per cent of the homes are wired for electricity.

In striking contrast geographically, Denmark comes next. It is 72 per cent wired. Next comes another flat country in the highly developed western portion of Europe, the Netherlands, with 50 per cent, and then Norway, vastly larger in area but having a population only a third as great, with many of its magnificent water powers already developed and also with half its homes supplied with electricity. Last in order comes Greece, with but one home wired in a hundred.

It should be stated that in the cases of Italy, Norway, Portugal and Sweden the original data do not state the number of homes. For the purpose of the present comparison estimates have therefore been made based upon the total population.

Further, the estimated number of homes both in Switzerland and in the Netherlands seems small in proportion to the population. If it were increased so as to bring these countries more nearly in line with the others the percentage in question would have been materially reduced. Nevertheless, Switzerland would probably still be at the head of the list.

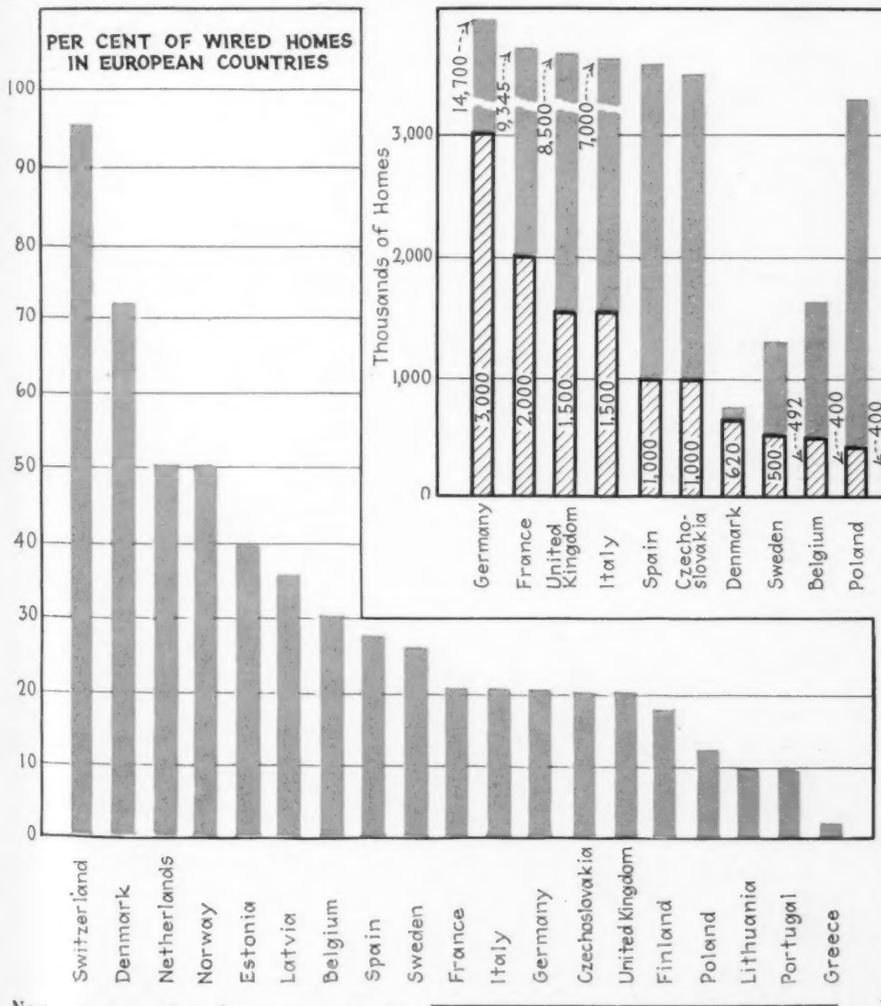
Some of the figures are admittedly merely approximations. They are presented as the best information now available and are subject to revision upon the receipt of more accurate data.

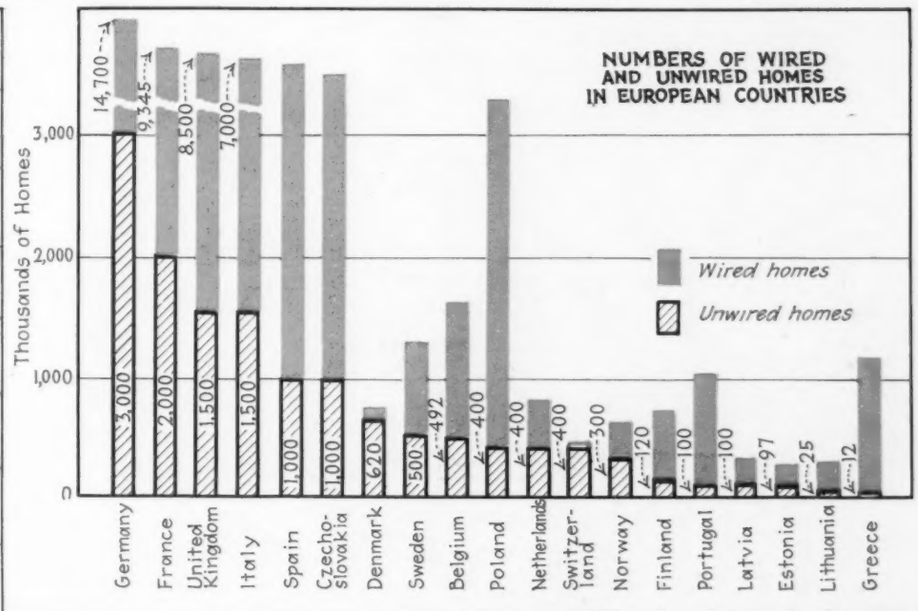
Comparison of the actual numbers, instead of percentages, changes the sequence. The four leaders, Germany, France, the United Kingdom and Italy, together have about 8,000,000 wired homes, or half as many as the United States, and the proportion in each is much smaller than our 58 per cent. The smaller states necessarily rank lower in the scale. The chart showing actual numbers also brings out the great possibilities for future developments.

Evidently these are closely interrelated with national prosperity. The older forms of lighting have served heretofore and can continue to be used. For an impoverished population the wiring of a home involves a large investment. That investment is possible only after the more pressing needs of food, shelter and raiment have been met.

Moreover, from the marketing standpoint, a European home does not offer the same opportunities as one in the United States. It has been stated that the number of outlets per wired home is, on the average, much lower there than here. This, again, depends upon the investment the home owner is able to make.

Apparently Europe is still practically an undeveloped field for wiring devices and domestic appliances; the rapidity of its future development is closely connected with the economic welfare of the population. As the development proceeds much of the material will, no doubt, be supplied by manufacturers within the respective countries; a certain percentage of it may, however, reasonably be expected to come from the United States.





Most of the data for statistics in the ELECTRICAL WORLD are gathered by it from original sources. Privilege is freely given to readers of the ELECTRICAL WORLD to quote for use these statistics for any legitimate purpose. While there is no requirement that the source of data be given, yet it would help the ELECTRICAL WORLD in obtaining and compiling further basic information if those who make use of these statistics would give credit to the ELECTRICAL WORLD.

Industrial Outlook in Middle Atlantic States Favorable

THAT the first quarter of the present year at least will witness a continuation of the high industrial productive operations which were prevalent in the Middle Atlantic States during the last half of 1926 is indicated by the reports of consumption of electrical energy during January received by the ELECTRICAL WORLD. In fact, January production of manufacturing plants in this section was 2.1 per cent over that of December, but an increased production was to be expected during January because of seasonal influences. Approximately the same rate of increased production manifested itself in January, 1926, as compared with December, 1925.

The most significant fact connected with the productive operations in the Middle Atlantic States during the past three months, however, is that production has been slightly under that reported for the same months of the year previous. November, December and January production has been approximately 4 per cent under that of the same months of 1925 and 1926. This would seem to bear out the opinion of students of industry that general industrial production during 1927 would be slightly under that of 1926, but that no general slump in production is indicated by present economic conditions. These industrial conditions in the Middle Atlantic States during the past few months have followed very closely general industrial conditions in the country as a whole. Such is the present status of productive operations in the manufacturing plants of the Middle Atlantic States as indicated by the monthly consumption of electrical energy by some four hundred large plants scattered throughout the section and in various industries.

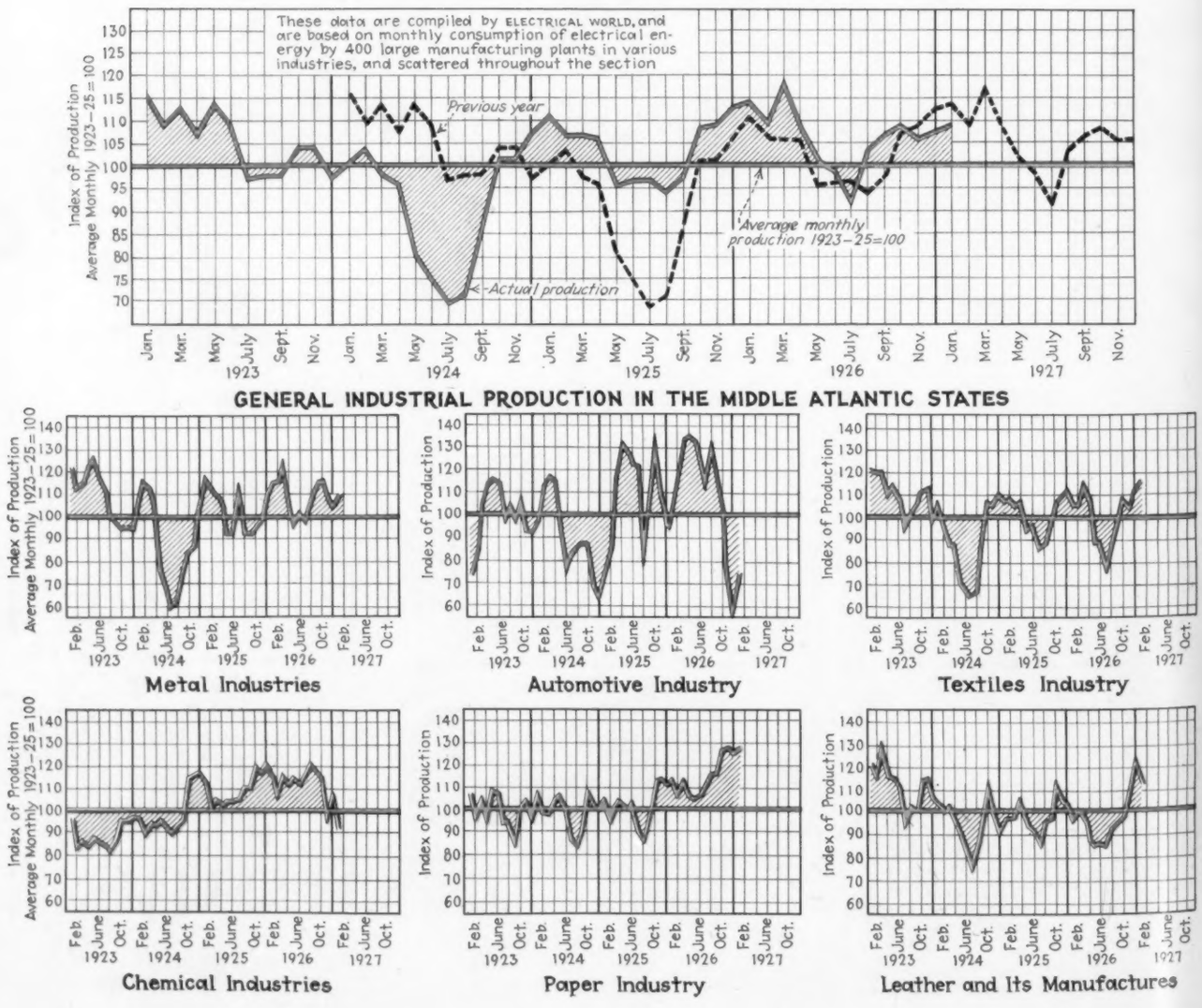
It is estimated that the iron and steel plants of the Middle Atlantic States were producing at approximately 87 per cent capacity during January. Activity in metal industries as a group, including both ferrous and non-ferrous working plants, during January was 4.6 per cent above December, but was 4.7 per cent under January of last year. In December and January production was below that of the previous December and January.

The upward trend in the activities of the textile industry, including all branches from the mill to the tailor shop, which trend started in August, was continued through January, operations for the month being the highest since March, 1923. Operations in the "leather and its manufactures" industry reached a peak in December, the January operations being about 8 per cent under December.

"Electrical World" Barometer of Industrial Production in the Middle Atlantic States

(Data Unadjusted for Seasonal Variation)

States in the Middle Atlantic Group: New York, New Jersey, Pennsylvania


These data are compiled by ELECTRICAL WORLD, and are based on monthly consumption of electrical energy by 400 large manufacturing plants in various industries, and scattered throughout the section
Index of Production Average Monthly 1923–25 = 100
Previous year
Average monthly production 1923–25=100
Actual production
Jan. Mar. May July Sept. Nov.
1923 1924 1925 1926 1927
GENERAL INDUSTRIAL PRODUCTION IN THE MIDDLE ATLANTIC STATES
Feb. June Oct.
Metal Industries
Automotive Industry
Textiles Industry
Chemical Industries
Paper Industry
Leather and Its Manufactures